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ETHNOLOGY.—*The mutual-aid and volunteer company of the eastern Cherokee: as recorded in a book of minutes in the Sequoyah syllabary, compared with mutual-aid societies of the northern Iroquois.*[1] F. G. SPECK, University of Pennsylvania, and C. E. SCHAEFFER, Pennsylvania Historical Commission. (Communicated by W. N. FENTON.)

In the progress of field research in the Southeast during the past decade, a growing mass of data describing the institutions and social life of the Cherokee has come into our hands. The Cherokee constitute an important study group of North America whose way of life became strongly and strangely modified more than a century ago by deliberate movement toward acculturation; they took up learning and its institutions through association with Europeans. The Cherokee became literate in about the first quarter of the nineteenth century, by which time one of their intellectual leaders, Sequoyah, the Cherokee Cadmus, had given his people a system of quasi-syllabic symbols, enabling them to record in writing their own cultural properties. Scribes replaced oral transmitters of knowledge. Not only this, but the acquisition of innovations in the whole gamut of their economic life transformed the group from mountain-dwelling hunters and mountain-valley maize-growers into mountainside cropfarmers, husbandmen, artificers, traders, and sedentary villagers in a space of time so short and phenomenally progressive as to arouse the envy and jealousy of the frontier settlers who first brought these changes across the horizon of the "savages."

The aforementioned changes in the cultural trend of the Cherokee are too well known to need reviewing. Such causes furnished the social and political background out of which the Removal Event evolved in 1836. The works of Adair, Timberlake, Royce, and Mooney abound in treatment of this epoch in southern history. Forman, Debo, and Milling, among others, have ably narrated the historical episodes. And the transition from former conditions of life to those of the post-Contact period has engaged the attention of modernly trained anthropologists, such as Olbrechts, Bloom, Gilbert, and Kelly, whose publications have already appeared. The latter group have cross-sectioned and analyzed, through extensive field work among the conservative members of the Eastern Band in North Carolina, the manifold aspects of the physical, spiritual, social, economic, and political elements under historic changes of cultural life.

[1] Received January 18, 1945.

THE LITERATURE ON COOPERATIVE ENDEAVORS

But now leaving this review we come to a consideration of one characteristic of native life which is increasingly stressed by students in discussions of the structure and functioning of Cherokee society. Reference is thus made by Olbrechts,[2] Bloom,[3] and more exhaustively by Gilbert[4] to the importance of cooperative endeavor and the various Cherokee social forms, both formal

[2] JAMES MOONEY and FRANS M. OLBRECHTS. *The Swimmer manuscript: Cherokee sacred formulas and medicinal prescriptions.* Bur. Amer. Ethn. Bull. 99: 1–319. 1932.

[3] LEONARD BLOOM. *The acculturation of the eastern Cherokee: Historical aspects.* North Carolina Hist. Rev. 19 (4): 323–358. 1942.

[4] WILLIAM HARLEN GILBERT, JR. *The eastern Cherokees.* Bur. Amer. Ethn. Bull. 133 (23): 169–414. 1943.

and informal, through which it derives expression. Our primary concern in this paper is with certain of the more formal cooperative units representing voluntary, associative "companies" of men organized for the purpose of mutual aid and charity. In addition to placing on record heretofore unpublished but specifically literal data, we propose to examine these institutions from the standpoint of their wider, historical relationships. Thus the authorities cited above describe in greater or lesser detail the functions of these cooperative bodies, the scope of their activities, and the nature of their formation. In no case, however, has an attempt been made to scrutinize the associations themselves from the viewpoint of the wider background of aboriginal social systems of the Atlantic slope area.

The fact that recent writers on the Cherokee welfare company have refrained from searching farther afield for genetically related institutions obscures its significance as a societal trait shared by the northern Iroquoian linguistic relatives of the Cherokee. Can the mutual-aid agency of the Cherokee be shown to have a historic connection with the similarly associated company reported among the Iroquois (Seneca) by Fenton? If so, does it represent one of the fundamentals of Iroquoian culture predating the separation into northern and southern divisions? Beyond the unquestioned relationship of speech between the two, ethnologists and archeologists have still to define the fundamentals of Iroquoian social ideology as well as correspondence in material culture. Having called attention to the bearing of these thoughts upon the wider aspects of community life in the Eastern woodlands, we may postpone for the present further examination of their latent possibilities.

Reverting to the published accounts of the Cherokee cooperative agencies, the principal facts on record may be briefly summarized as follows: Economic cooperation in Cherokee society, according to Gilbert (p. 307), is manifested both above and below the institutionalized level, in a variety of forms. As representative of the less formal types, he mentions the simple exchange of services and goods between husband and wife, and between neighboring farmers, and certain spontaneous communal activities, i.e., construction of a foot bridge for the common good. The voluntary, organized, associative forms, on the other hand, are represented, among others, by (1) the poor-aid companies and (2) the *gadugi* or mutual-aid associations.

Gadugi.—The Cherokee *gadugi*,[5] or Mutual Aid-association, is defined by Gilbert (p. 307) as a "company organized for the purpose of mutual exchange of services and earnings of money." The following data, paraphrased from the same observers' description (p. 212), provide us with an outline of its structure and activities. The *gadugi* is a group of 12 men organized as a corporation. Its services are hired out to white farmers at nominal rates of pay, or allocated, in rotation, to members' farms for four days of the week. The tasks performed include ordinary agricultural activities, such as hoeing corn, "topping" corn for fodder, and clearing land for cultivation. Cash returns derive from an annual division of the corporation's profits or, when desired, through a loan on the common treasury secured by a mortgage on the member's livestock, land, or dwelling. Officials of the *gadugi* include the chief, treasurer, secretary, sheriff or money-collector, and warner, each of whom is elected annually by the members. Of these, the most important are the chief, who hires out the company, and the warner, who is in charge of actual labor supervision. Often two or three women, serving as cook-laborers, are members of the society.

Poor Aid company.—The Poor Aid company differs from the *gadugi* largely in the nature and orientation of its activities. The former is characterized by Gilbert (p. 307)

[5] Bloom (p. 326) notes in passing that "a cooperative, the *gadugh*, was a distinctive feature of Cherokee society. Gatherings for community work were occasions for social diversions and had much the same motivation and aspect as the 'bees' of colonial and rural America." Olbrechts omits any mention of the *gadugi*.

The Cherokee term is *gàdugi'*, translated as "welfare society" in modern usage, denoting the Red Cross and other organizations operating for public benefit.

as a "form of mutual aid among neighbors when sickness or death disables one of the families." The officials of the poor-aid agency, according to Gilbert (p. 213), consist of a chief, undertaker, secretary, gravedigger, coffin-maker, and two warners.[6] Of these, the chief serves as director of poor aid while the warners act as his assistants. The association, which is apparently made up of all the able-bodied members of the community, comes together once a year to hold a meeting and elect officers. In the Raven district, where Gilbert carried on his investigation, the annual meeting is held regularly in the community cemetery on August 10.[7] The election is quite informal and usually consists in nomination of popular individuals, by two or three of their friends, and oral assent of the remainder. Following the meeting the assembly cleans up the graveyard and straightens up the tombstones.

The functions of the Poor Aid association consist largely in lending assistance to families in need. For example, if the head of a family falls ill and is unable to provide care for his family, the chief requests the two warners to go around and collect the neighbors. In such an emergency the chief can command the services of the community on three days' notice during the growing season, and at other times immediately. All the able-bodied people turn out to provide firewood and to plow the family's fields, plant and hoe the corn, and, finally, to gather the harvest. In case a family's house burns down, the association also assists in rebuilding and refurnishing it. It is important to note the reciprocal aspect involved, for, as Gilbert (p. 307) points out, "payment for these services is, of course, expected either in kind [chickens or livestock] or in return services."

As suggested by the list of officials previously cited, important cooperative functions were carried out by the Poor Aid association in connection with death and burial. Olbrechts' discussion (pp. 135–38) of its activities on such an occasion follows:

> As soon as it is known that some one has died, the head man of the "grave-digging company" is notified; he, in turn, gives notice to his helpers, and the same day or the next a grave is dug.
>
> The grave-diggers are a company of six volunteers acting under a chief; the latter office at the time of my stay being held by one Gula·'ci. They also are appointed for one year, and are elected in the same manner as the coffin makers . . .
>
> The coffin is made by two men acting under a foreman. This "company" is elected for the term of one year, at the same time as the "grave-digging company" and the chief of the settlement.[8]

Upon the close of the mourning rites at the home of the deceased, the corpse is borne to the burial place under the supervision of an aid company official. According to Olbrechts (pp. 137–38):[9]

> At a sign of the chief of the coffin makers, four men will start hunting around for two stout poles or strong boards on which the coffin is put to be carried, and the funeral procession starts . . . Every 200 yards or so the chief of the coffin makers who now acts as a kind of "master of ceremonies," shouts out anisɔ'i' nɔ·ⁿGwɔ̃ⁿ' ("other ones now"), and four other men, not necessarily belonging to this company, come out of the crowd and take the places of the coffin carriers . . . When the cemetery is reached, the coffin is put down near the grave which has been dug in the meanwhile by the grave-digging company . . .

So much for the guise in which the Cherokee welfare agencies have come down to us of recent years. That they existed in the tribal society of the Southeast in general is satisfactorily acceptable in view of the testimony in the narratives of writers who knew the Creeks and Cherokees in the latter part of the eighteenth century.[10] In

[6] The officials, as given by Olbrechts (p. 80), are the chief and an assistant whose duty it is to call out the members. The former is said to be regarded pretty much as the chief of the community. Farther on in his account (pp. 135–38), he mentions other officers who carry out certain duties in connection with burial.

[7] Olbrechts (p. 80) states that the annual meeting usually takes place "at corn planting time when members have to meet anyway to work for some sick neighbor."

[8] Olbrechts goes on to state, "The election is a very unofficial affair, the members generally being volunteers. The foreman, and if necessary one of the two members, if there are no volunteers, are nominated and usually, ipso facto, elected."

[9] Gilbert's data (pp. 213, 256) follow closely those of Olbrechts on this subject. In another place the former (p. 347) states that formerly every Cherokee town had its undertaker who not only buried the dead but assisted the deceased's family in carrying out certain post-mortem mourning rites.

[10] Gilbert (p. 306) characterizes both agencies (1932) as "aboriginally remnantal organizations

the case of the Poor Aid association, we may refer to William Bartram and his recorded observations on the above-named tribes. He states that "the citizens, as one family, prepare the ground and begin to plant . . . as convenience may direct for general good. The work is directed by an overseer elected or appointed annually, I suppose, in rotation throughout all the families of the town. Thus when a family's private stores fall short, in case of accident or otherwise, they are entitled to assistance and supply from the public granary by applying to the king . . . "[11]

The Poor Aid company, however, underwent progressive disintegration within the last century as the result of influences arising from European contact. We are indebted to Gilbert (pp. 362–63) for a résumé of the events leading to the decline of the cooperative at Yellow Hill, one of the communities on the Cherokee reservation:

> In the late 19th century the American Government took over the work of the Quakers in the education of the Cherokees, and began an active program of bringing the younger generation into the Government day schools. In Yellow Hill a manual-training course was set up for the boys, and the latter were taught to make various handicraft objects. Among other things coffins began to be made at this school, and soon the whole town was supplied from this source and the coffin-maker lost his job. The office of undertaker was also made less useful and the whole of the funeral functions of the Poor Aid Society vanished. Soon the effects of the native health and welfare service of the American Government made itself felt and the rest of the functions of the Poor Aid Society vanished also. So it has come about that the cooperative and mutual aid among neighbors in sickness and death have disappeared in favor of direct Government aid in Yellow Hill.

Having surveyed the published material on record for the Cherokee cooperative organizations, we may now set forth additional information on the Poor Aid company as acquired recently from native sources among the Cherokee. These data are taken from a record written in 1932 by Will West Long in the Cherokee syllabary script, and obtained from him in 1944 with a collection of manuscript records in the famous syllabary.[12]

TRANSLATION OF SYLLABARY

Introduction.—In making a translation of the text of the syllabary several difficulties have had to be considered. One of these was the selection of English terms from the vocabulary of West Long to coincide with the sense of the Cherokee original. Such terms as "elected," "votes," "unanimous," "chairman," and "secretary," and others taken from the diction of parliamentary procedure, must impress one as obviously of modern structure and not a part of the basic Cherokee vocabulary of pre-Contact times. The tone of the whole record, in fact, betrays the effect of a far-reaching influence from European sources. There is nothing in such a conclusion to surprise one who recalls that the Cherokee, by the middle of the previous century, had well earned their title

which function feebly today and seem to be destined to soon disappear." He has collected data to show the presence of the *gaduqi* as a cooperative agency among the Cherokee during the early 19th century. The company persisted relatively unchanged until 1890 after which it underwent rapid modifications. It then began, to quote Gilbert (p. 362), to "hire out its services to white people at fixed rates by the day and became in effect an ordinary labor gang. This change in function led to dependence on white people for wages and subsistence instead of a reliance on their own unaided cultivation of the soil by mutual aid. Consequently the association came under the North Carolina regulations as a corporation and became subject to taxation. Unable to meet the taxes from their earnings, the *gaduqi* soon declined and mostly disappeared in the opening years of the twentieth century."

Reference is made to this *gaduqi'*, or society, in one of the handwritten journals obtained for the University Museum from West Long himself. Some details of the action of the society are given by one of its members Kètəgisti', from whom West Long had obtained the records about 1906. It is still untranslated (MS. Book III, p. 67).

[11] Quoted by Bloom, p. 329.

[12] The notebook in which the text was written is a small composition tablet in which West Long, as an officer of the Poor Aid company, wrote down in full the acts, minutes, and proceedings of a meeting held by its members at the Big Cove settlement of the Cherokee in one of its final sessions.

Within the past few years a collection of handwritten books in the Cherokee syllabary, known as the Sequoyah alphabet, has been made and placed in the archives of the University Museum, University of Pennsylvania. The paper submitted is based upon one of these documents. Acknowledgements are due to the Faculty Research Fund of the University, and to Robert Riggs, for support of the initial field work in the area which resulted in securing the manuscripts for the University Museum.

as one of the Five Civilized Tribes of the South. That the cooperative-work units of earlier times should have become organized after the pattern of colonial American town-meetings, is as much to be expected in Cherokee social policies after 1850, let us say, as their progress in literacy,[13] or their change of governmental policy from village to tribal chieftainship and confederacy, and finally, to an elective system with chief executive and house of representatives or councilmen.[14] The data pertaining to acculturative processes at work in the social and political history of the Cherokee have been too well overhauled in the monographs of Bloom and Gilbert, already mentioned, to require more than casual reference in this connection. The proclivity of the Cherokee for progressive acculturation need not surprise one, even under an accelerating momentum between 1720 and 1830, when Bloom's statement is weighed. He asserts, in comparing white frontier and native Cherokee culture, that by 1800 "the frontier presents the intruding culture in a cruder and simpler, perhaps a more elementary form."

In presenting the translation of Will West Long's minute book, we have used parentheses to inclose words not appearing in the original text. The punctuation is that of the present writers, since the syllabary has none. The native terms are transcribed phonetically following the system, with some simplifications, employed by Dr. Olbrechts. Will West Long is responsible for the translation and for the transcriptions and renderings of the personal names listed. It must be remarked that West Long is a purist in Cherokee pronunciation, diction, and style; hence his renderings and etymologies will often vary from those of other speakers who act as informants on Cherokee topics.

Organization and procedure.—Without going into matters that are only indirectly concerned with the functional aspects of the mutual-aid unit, we offer some observations on the procedures of the company during the final meetings held at Big Cove.

West Long remembers that each village settlement community of the Nation, before the era of its political dismemberment in 1836, the time of the Removal to Indian Territory, had what he calls a "lead-chief" or "little chief," *usti·'yu ukɑwi·yuhi·'*. Each settlement managed its own affairs of a public, legislative, and social nature as a small independent community unit or tribe. The community chief or "lead-chief" was the social factor in organizing the group's activities and formulating policies. He administered his control through a body of 12 men, known as *ani' tawiskagei·'*, "smooth men," whom he appointed. They served as police or sheriffs, having official authority to arrest and punish, according to tribal mores, men and women guilty of misdemeanor. They reserved the right to decide the degree of punishment for minor offenses by whipping with sticks (four to twelve lashes), or they could even pronounce acquittal. The mutual-aid cooperative, of which we treat, was a branch of this arm of community organization; its officers were appointed by the company itself, and authorized by the community lead-chief. Since it may not find elsewhere a niche in the records of the Eastern Cherokee, it is interesting to note here a fact of band history: West Long remembered that the last lead-chief of the Big Cove Settlement was *Tsiltaɔ'ski·*, "Falling corn-tassel."[15] The office fell into disuse about 1875, according to his recollection. But the aid company at Big Cove continued to function as a work group until shortly after 1932, the date when the text of the last meeting minutes was written. A decade later, as we write, the company still functions in part, although the Agency staff has taken over some of its tasks as a phase of paternalistic policy.

The native designation of the cooperative association, as given by West Long at the time of translating the text, is *uyo'i·yun dahnde'gi·'*, literally "poor people needy (company)." The meeting referred to in the

[13] In 1848 "about three-fourths can read in their own language," meaning the Sequoyah syllabary (Bloom, p. 355, quoting Lanman).

[14] The last a "political instrument modeled on that of the United States" (Bloom, p. 349).

[15] The Anglicized form Chiltoski is still current as a personal name in the band.

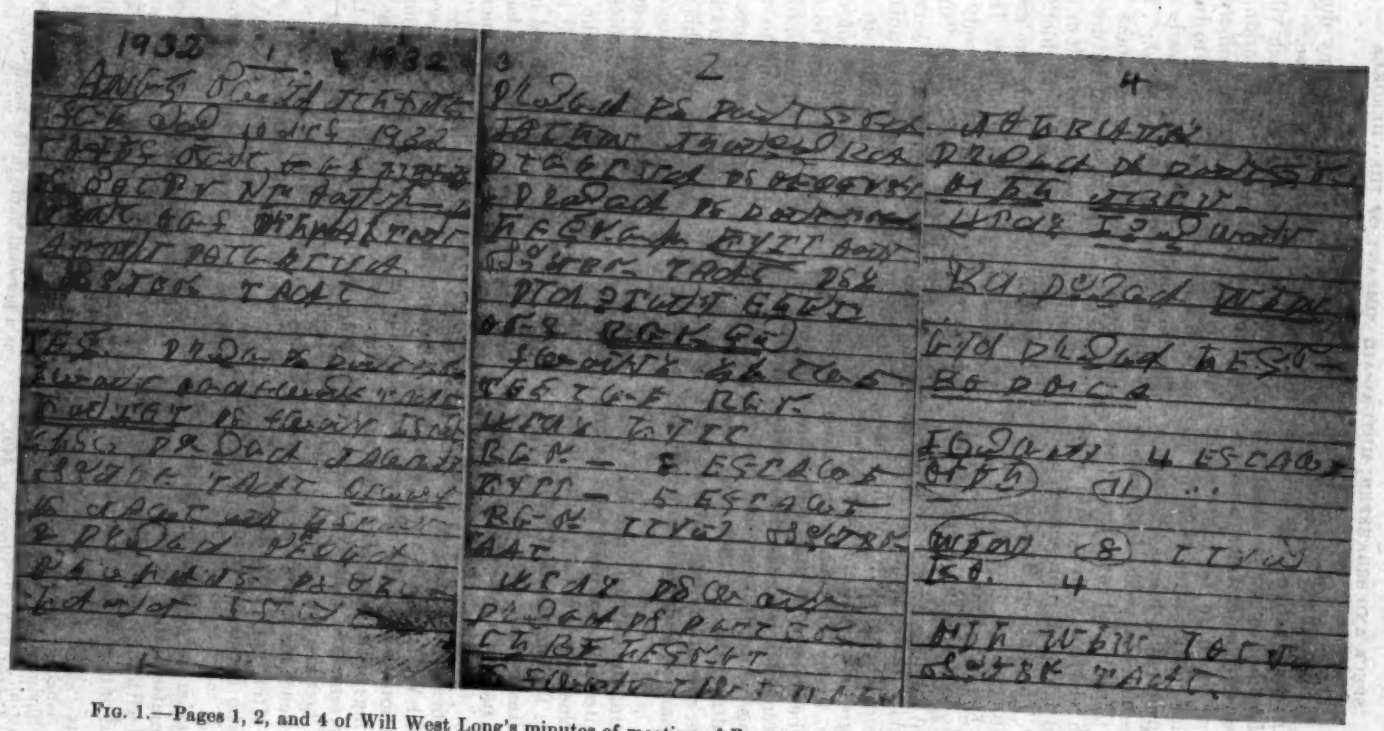

FIG. 1.—Pages 1, 2, and 4 of Will West Long's minutes of meeting of Poor Aid Company, Big Cove settlement of the Cherokee. Written in the Sequoyah syllabary, 1932.

minutes took place at the graveyard at Big Cove as the opening phrase of the text indicates. West Long explained that the outdoor gathering on the occasion was held to clean up the burying ground while the people were assembled for the meeting. (The community has since discovered that the labor of cleaning the graveyard can be saved by pasturing their cattle there to eat off the weeds: Acculturation accelerating economic progress.) The meetings of the organization are now usually held in someone's home. The place is determined by appointment each year and tends to follow a rotation among the families of the settlement.

The tasks of the benefit program of the company fall upon the whole community as ordered by the appointed officers, as West Long, the secretary, explained. This means that, then as now, 20 to 30 persons would constitute the work party. He estimated that about 40 families made up the Big Cove settlement, including those of remote Cherokee descent. Most of them attended the meeting covered in the minutes recorded, and the votes, numbering 27 (page 4 of the text), represent the highest number of males voting on any office of the society, namely, that of notifier.

With this brief review of the occasion, we now turn to the record of the meeting itself.

MINUTES OF A MEETING OF THE MUTUAL AID SOCIETY HELD AT BIG COVE SETTLEMENT, CHEROKEE RESERVATION, N. C. (TRANSLATION OF A DIARY RECORD OF WILL WEST LONG, 1932)

Page 1

Raven's old grave yard, August 10, 1932, held meeting and organized to make as a company, renew it and reelect its officers for as long as one year.

First, motioned it and seconded it, chosen as temporary chairman, Tciskwą'na?į'.[16] Next motioned and seconded, chosen Will Westi[17] as secretary for one year. Third, motioned and seconded, chief head to make speech (explaining) what he has done, also other officers.

[16] Literally "bird going," commonly known in Big Cove as Going Bird.
[17] Cherokee form of Will West (Long).

Page 2

Again motioned and seconded: to person who has had any trouble or sickness, to support and help them; Tcikilili·'[18] will be the head as long as one year.

Then, the volunteer (candidate) to run against (Tcikilili·'), Lloyd Wahi·ya'.[19]

Ordered and given them to vote, voted first Lloyd, then last Tcikilili·'.

Lloyd—8 votes.

Tcikilili·'—5 votes.

Lloyd was elected for one year.

Next, assistant chosen, Djáni Es·i'[20] reelected. Chairman allowed him a vote, ran against him, for one year.

Page 3

Next, dead person's coffin-maker, there should be elected again. Chairman allowed them to vote. Diyelidɔ'[21] should be reelected. They all voted unanimously.

Next, graveyard-digger, motioned and seconded, should be reelected Gwəla'dzi·[22]

Next motioned, Kotagwa'ski·,[23] foreman, appointed against Gwəla'dzi·.

Gwəla'dzi·—5 votes.

Kotagwa'ski·—10 votes.

Kotagwa'ski· elected for one year.

Page 4

Notifier, motioned and seconded, Mason Driver, next Djunu'ləhəski·'.[24]

Next motioned Lasil·a'',[25] motioned elected, reelected Djo'na Amatzonᵩ''.[26]

Djunu'ləhəski·'—4 votes.

Mason—11 votes.

Lasil·a''—8 votes, elected.

Djo'na—4 votes.

Mason, Lasil·a'' elected for one year.

Page 5

Motioned and seconded, Djo'sa Wahiy'ᵩ[27] reelected coffin-maker—elected.

Next, second assistant coffin-maker, mo-

[18] Literally "chickadee," locally known as Chikilili Driver.
[19] Literally "wolf."
[20] Cherokee equivalent of John Jesse (Lawson).
[21] Literally "driver," known as Will Driver.
[22] Literally "echo," known as Gwolidge Wati.
[23] Literally "all day long" (Sunday).
[24] Literally "failer."
[25] Cherokee form of Russel.
[26] Literally "Jonah back in the water"
[27] Equivalent of Joe "Wolf."

tioned and seconded, let it be reelected Djáni Diyelidɔ'hi'.[28]

Motioned and seconded Ma'ka Tsǫtatsj'[29] assistant.

Djáni Diyelidɔ̀hi'—2 votes.

Máka Tsǫtatsj'—11 votes, elected.

Page 6

Motioned and seconded: if superintendent[30] has an interruption, half-time assistant has to take authority; right to give order to notifier, to help them (people), but first he has to go to find out if it is necessary to help them.

Motioned and seconded: if anyone is an old man, very old and helpless, also some old woman, cannot help herself and is living by herself, he (or she) in anything can be helped; seconded.

Page 7

Foreman or superintendent, to give order must give advance notice three days before, but if it is hoeing corn or cutting wood, then just at any time he has right to give orders to work.

COMPARABLE SOCIETIES AMONG NORTHERN IROQUOIS

Turning now to the northern Iroquoian peoples, or Iroquois proper, we see that the recorded data reveal that patterns of mutual aid and assistance were as characteristic of their economic life as that of their southern congeners. We are indebted to Fenton (p. 43) for information on the type of mutual-aid association existing at the present time among the Seneca of New York State.[31] The Seneca unit is organized not only for joint economic benefit but also incorporates the added function of group-singing for pleasure. Both men and women are members; but the former comprise the singers. The officials of the association differ apparently in number and in scope of duties on the various Seneca reservations. At a recent meeting (1935) on the Tonawanda Reservation, one of these companies, the Salt Creek Mutual Aid and Singing Society, was organized, and a chairman, secretary, treasurer, and two poormasters were elected by the members to serve for one year. The activities of the group include cutting wood for families with sickness, "raising" houses for members, and lending aid to indigent old people. Anyone may approach either of the poormasters and request assistance. When help is thus requested, a "bee" is organized, and, after the day's work, the company sits down to a meal provided by the family in receipt of aid. Parenthetically, it may be pointed out that the reciprocal aspect noted previously for the Cherokee is also present here. After the meal the evening is given over to singing and dancing among the members present. "Similar mutual aid and singing societies prevail at Allegany Reservation, where there were two in 1933–1934, at Cattaraugus, and at Six Nations Reserve" (Fenton, p.c.).

It is worth pointing out that upon two occasions the Salt Creek Singers volunteered to manage funerals in the community (Fenton, p. 42). The cost of lumber having been provided by a state welfare agency, the company delegated to one of its members the task of making the coffin. Thereafter the duties of preparing the body of the deceased, conducting the wake, digging the grave, and preaching the funeral sermon were assigned by the aid association to members of the deceased's opposite moiety.

The modern mutual-aid companies of the Seneca undoubtedly represent a development from native cooperative work groups of the Colonial period. In tracing their antecedents, Fenton (p. 13) notes that, according to current native tradition, "the Singing Societies grew out of groups of men who helped the women . . . Anciently the Chiefs were responsible for the welfare of the people. They could go to a society and ask it to assist a family." Later, the same authority notes, the societies assumed the proportion of singing companies with definite organizations, because of the traditional tendency for Indians to sing and

[28] Equivalent of Johnny "Driver."
[29] Literal equivalent of Mark "Panther."
[30] Referring to Chikilili Driver.
[31] WILLIAM N. FENTON. *Some social customs of the modern Seneca.* Social Welfare Bull. 7 (1–2): 4–7. New York State Department of Social Welfare, Albany, N. Y., 1935. Also reprinted in Indians at Work 3 (21): 10–14; 4 (6): 41–42. Office of Indian Affairs, Washington, D. C., 1936. Present page references are to the latter source.

dance when gathered in social groupings: the family, the clan, the locality or the nation. "But their original purpose—charity and mutual aid—still obtains."

Another type of mutual-aid association common to the Five Nations of the earlier period is presented to us in a report by Parker.[32] This form differs largely from that described by Fenton in the composition of its membership. Before outlining the data on this second agency, it is necessary first to sketch in the general economic background of the northern Iroquoians. The Five Nations, a group of sedentary agriculturalists like the Cherokee, based their subsistence upon maize-growing. In contrast to the latter, however, Iroquois maize production—planting, cultivation, harvesting, storing, and final processing as food—was carried on almost exclusively by women. Men assisted in clearing the fields, older men occasionally aided the women in cultivation, but the predominant male pursuits were warfare and hunting. Even the chase, at times, was carried on in an intermittent and desultory fashion. Since the burden of economic responsibility was thus borne by women, it is no surprise to learn that cooperative work groups among the Five Nations of the Colonial period were primarily female organizations.

The mutual-aid company that functioned in all agricultural activities was usually composed of women from the entire village. Each year, according to Parker (p. 24), they elected a chief matron to direct their work in the communal fields. These were plots of ground associated with the matrilineal family (clan) or the village as a whole. The produce from the village fields was employed for the preparation of food required in the tribal festivals, the excess frequently being distributed among needy families of the village. The aid-company leader, usually a matron from the dominating family, ordered all the details of planting, cultivating, and harvesting. She was assisted by several lieutenants, matrons selected by her from other family lines. The fields connected with the village were cultivated, one by one, in this way. Early in fall the work company came together to harvest the crops. This was an occasion for festivity, the men attending to take part in the singing and dancing. It is interesting to note Parker's statement (p. 32) that the aid company also tended the crops of sick and injured members, *a service considered as a right and never as a charity* (italics ours). It may be inferred from the above writer that the women's aid association continued to function among the Five Nations down to the last century, by which time male reluctance to participation in agricultural work, under the stimulus of state and federal government and missionaries, had begun to wane.

The existence of still another variety of the cooperative work association is also noted for the Five Nations by Parker. This type functioned in connection with the utilization of certain fields near the village, the use of which was regarded as the property of individual families. According to Parker (pp. 29–30), the women of the community in whom such rights were vested and their husbands or male friends might form a mutual-aid company. Like the exclusive women's work-group previously discussed, the activities of this association were directed by a matron selected from among the members. As long as members' obligations toward cultivation of the communal fields were maintained, they were privileged to carry on the necessary work in their own plots. Few data are afforded us, however, as to the particular role played by male members of the agency except that they helped at husking, knowing that a full pail of corn soup awaited them whether they worked or not. "Often the 'bee' would be enlivened by a marching dance, and for this emergency the men brought their water drums and horn rattles and cleared their throats for singing" (Parker, p. 32). The dual-membership cooperative group is, perhaps, best regarded as a variant of the women's aid-company.

In summary, then, we have presented data describing certain cooperative associ-

[32] ARTHUR C. PARKER. *Iroquois uses of maize and other food plants.* New York State Mus. Bull. 144: 21–32. 1910. Also see ALEXANDER A. GOLDENWEISER. *Early civilization: An introduction to anthropology:* 72–73. New York, 1922.

ations present among the modern Seneca and Cherokee. Further, we have reviewed the more accessible sources for information upon antecedent and coexisting forms in the same cultures for the earlier historical period. Both the recent and earlier types of Iroquoian economic agencies reveal pronounced similarities as well as differences. Despite the dissimilarities, it is the writers' opinion that the two sets of tribal institutions are genetically related, and reflect, in turn, an old, fundamental pattern of institutionalized cooperation and poor-relief characteristic of and deeply embedded in Iroquoian culture. The reasons for so thinking are set forth in subsequent paragraphs.

In delineating the form and function of the economic institutions antecedent to contemporary Iroquoian mutual-aid companies, it is first necessary to set aside those accretions that have attached themselves to the base pattern during the course of recent centuries. Thus, if the Cherokee *gadugi* be screened of such alien elements as the corporate and parliamentary framework of organization, services for hire, loans to members, etc., the simpler form characteristic of the Colonial period remains as a residuum. The primary function of the Cherokee agency is then revealed as mutual exchange of services for economic ends. It is probable that the association during this earlier period was organized on a community-wide basis and operated under the direction of a leader and several assistants. As thus depicted, the parent mutual-aid institution, except for its sexually mixed composition, equates essentially with the women's mutual-aid company of the Seneca. This divergence in membership composition, however, is of relatively minor significance when we recall the peculiar matriarchal trend of northern Iroquoian economy, and contrast it with joint participation of both sexes in agricultural pursuits among the Cherokee.

Similarly the poor-aid company of the Cherokee resembles its Seneca counterpart, the Singing Society, in functioning to alleviate economic distress. Fenton is of the opinion that the contemporary Seneca aid company is the lineal descendant of the sexually mixed cooperative agency described by Parker. In his opinion the latter can be regarded as the parent institution of the Singing Society in the earlier period. A clear line of development, in the light of our present knowledge, can not be traced between the cooperative agency discussed by Parker, and a postulated, dual-composition work-group believed by Quain (p. 249) to function in the onerous activities of land-clearing during the aboriginal period.[33] It is entirely possible that Fenton's "groups of men who helped the women" stemmed from some such aboriginal land-clearing agency. In this case, the dual-composition work-group merely represents the application of the basic pattern of institutionalized cooperation to the smallest, land-using unit in Seneca economy. The mutual-aid element may have become attached to what was once a predominately economic relief agency as the result of the decline in women's agricultural cooperatives and the increasing attention paid by Seneca men to farming.

To return to our comparison of the Seneca Singing Society and the Cherokee poor-aid company, it is clear that both agencies functioned to alleviate distress within the community, whether resulting from life-crisis situations or from ordinary economic need. Upon sifting out the parliamentary elements of organization shared by both, an earlier pattern of supervision, that of a leader and several aides, is revealed. Similarly, the native traits of reciprocity and formalized social diversion are common to the economic cooperatives of both tribes. Further, both Seneca and Cherokee aid companies are characterized by mixed membership since both men and women are members. If we again recall the sexual orientation of Five Nations economy, the society of males who aid the women during the earlier period appears complementary to the coexisting women's farming cooperative, both functioning toward common cooperative and charitable goals. A point of differ-

[33] B. H. QUAIN, chapter on "The Iroquois" *in Cooperation and competition among primitive peoples:* 240–281. Edited by Margaret Mead. New York, 1937.

ence between northern and southern Iroquoians is the role assigned to members of the Cherokee poor-aid company in execution of certain mortuary rites. These responsibilities accrue to the southern aid-group, apparently, as the result of the widespread Southeastern pattern of individuals other than relatives carrying on the rites leading to inhumation of the deceased. In the northern area, a similar attitude is not lacking in that the deceased's opposite moiety fulfills these obligations. Even here the Seneca poor-aid agency functions in an intermediary capacity. The Seneca aid companies also meet to clean graveyards.

As a result of the preceding analysis, the fundamental pattern of the organized, economic cooperative common to both Five Nations and Cherokee cultures comes to assume proper proportions. If the reconstruction of a prototype institution characteristic of archaic Iroquoian peoples in general be in order, it is to be defined as *a voluntary association of individuals, probably community-wide, organized under the supervision of a leader and several assistants to carry on mutual aid or relief activities within the locality on a reciprocal basis.* The lack of homogeneity in the tribal economic cooperatives of the recent period is assignable to (1) superficial accretions derived from European sources and (2) more fundamental modifications effected by varying streams of influence impinging upon the Seneca and the Cherokee, respectively, subsequent to their separation and dispersion.

As a result of tracing the economic agencies described to earlier levels of Iroquoian history, a fundamental trait characteristic of the cultures of this linguistic family is brought to light. We refer to the pattern of *institutionalization*, which so thoroughly pervades without relaxation the social forms of Iroquoian-speaking peoples in both northern and southern areas. Certainly one would search in vain among the Algonkians of the northern forests for indications of that capacity for economic, political, and social organization which so characterizes the life of their neighbors to the south, the Five Nations. Economic mutual aid is not entirely absent, it is true, among these less complex, hunting-gathering societies. However, it is never manifested through these organized agencies attributable to the Iroquoians but rather through the media of informal work-parties.

In evaluating the observations recorded in this paper, it must be borne in mind that institutionalization appears convincingly to have been an Iroquoian cultural property from the period of discovery down to the present day. We shall have to presume that such a statement is acceptable to students of the group. It is only by means of such a predisposing factor that the rapid assimilation, for example, of Europeans patterns of organization by Seneca and Cherokee alike during recent centuries, is most satisfactorily explained. *The common basis thus provided for the mutual aid groups in both areas affords increased evidence of cultural linkage in the past between two Iroquoian-speaking peoples who differ otherwise in most respects as to their cultural profiles. This substratum of social conformation in Iroquoian cultures represents a field of inquiry about which further information is desired.*

PALEONTOLOGY.—Gaulocrinus, *a new inadunate crinoid genus from the Mississippian.*[1] EDWIN KIRK, U. S. Geological Survey.

In the lower Mississippian of Kentucky and Tennessee is a small group of anomalous crinoids. In the main the species have been referred to the Pennsylvanian genus *Stemmatocrinus*, though one has been described as *Mespilocrinus*. Material showing the arm structures has been prepared, and the crinoids prove to represent a new genus.

Gaulocrinus, n. gen.

Genotype.—Stemmatocrinus trautscholdi Wachsmuth and Springer.

Crown. Low, massive, compact.

Dorsal cup. The dorsal cups range from cupuliform (type species) with flattened base and *IBB* not visible in lateral view through cyathiform to crateriform. In the deeper cups the *IBB* are plainly visible in lateral view. In most of the species the plates are very thick. In the holotype of the type species the *RR* have a maximum thickness of 8 mm. The *BB* and *IBB* have approximately the same thickness. This thickness is still greater in larger specimens. The species found in the New Providence of Button Mould Knob is a relatively small one and represented only by dissociated plates and one crushed dorsal cup. Here the maximum thickness of a radial is somewhat less than 4.5 mm. Owing to the great thickness of the plates in most of the species, the cavity of the dorsal cup is relatively small. The plates themselves are pyramidal in form, their dimensions on the inside of the cup being but approximately one-half those on the outside.

IBB. In most of the specimens the *IBB* appear to be fused into a solid disk. The greater part of the specimens, however, are silicified, which militates against accurate observations of sutures in the case of closely united plates. Several specimens seem clearly to show a single suture. In at least two specimens two sutures outlining a single infrabasal can be seen. As the cup is symmetrical there is no way of orienting the sutures as seen. The stellate outline of the infrabasal element in many of the specimens gives good reason to doubt anchylosis of the *IBB*. In all cases known to me where there is anchylosis in the proximal circlet of plates the resultant element has a symmetrical outline without reentrant angles. When two, three, or four elements result from fusion, reentrants are found only where sutures are shown, and even here they are usually not deep. In earlier days a great deal of stress was laid on the number and position of the elements in the proximal circlet. With greater knowledge we have found that such structures may be fairly stable and characteristic in some evolutionary lines and variable in others. Again, sutures may appear in individuals through what Wilson has styled delayed anchylosis. In the case of *Gaulocrinus*, with our present knowledge, the status of the *IBB* may be given as anchylosed with sporadic appearance of sutures. There is a distinct pit for the reception of the column. It is circular, deep, and has vertical walls. The pit is usually submedian in position, but in one undescribed species it seems to be consistently excentric in varying degrees.

BB. Large, usually extending to about one-half the height of the cup wall. An interesting feature in older specimens is the sinuous course of the basal-radial suture.

RR. Large. The radial facet extends nearly the full width of the radial. As seen in lateral view the *R-IBr* articulation ranges from linear to deeply lunate. The straight or slightly excavate contact is shown chiefly in young individuals or in what are assumed to be stratigraphically older species. It may appear, however, within a species in specimens of the same size as those showing decidedly lunate outlines. The distal face of the radial forms a broad platform. There is a well-defined fulcral ridge. The dorsal ligament fossa is relatively narrow but sharply defined. There is also a well-marked ligament pit. The muscular fossae vary with age. In younger speci-

[1] Published by permission of the Director, U. S. Geological Survey. Received March 16, 1945.

mens they are relatively shallow and have a papillose surface. In the largest individuals the fossae are deep and sharply defined. At the lateral ventral margins of the articulating face are triangular facets. Each of these combined with that of the adjacent radial forms a triangular depression that broadens and becomes shallower ventrad. At times, a low ridge delimits the inner margin of the depression. It seems possible that those areas represent interarticular ligament fossae.

Arms. The arms are heavy and short. In the two species where they are preserved, their length is less than the height of the dorsal cup. The *IBrr* are broad, low, and two in number in the two species in which they have been seen. In *G. trautscholdi* the rami do not seem to divide again. In one halfray there are six secundibrachs preserved. Judging by the rapidity of taper, one would hardly expect another division. In *G. bordeni* there is a second division on the seventh secundibrach.

Tegmen. No part of the tegmen has been found in any instance. In at least one specimen the cup is partially filled with dissociated brachials without recognizable plates that could have been derived from the tegmen. It would appear that the tegmen was an incompetent structure made up of many small plates.

Column. The column is known only in one specimen, where five of the proximal columnals are preserved. The column has a diameter of 5.0 mm and is circular in section. The columnals are of medium height and, as seen, all of approximately the same height. The sides are somewhat rounded. The face of the columnal is marked by fairly strong, radiating ridges. It is not possible to tell the shape of the lumen in the column itself. As shown somewhat indistinctly in the *IBB* it is pentalobate to pentagonal in outline.

Distribution.—*Gaulocrinus* to date has been found in place only in the New Providence of Kentucky and Indiana and an equivalent horizon in Tennessee. Most of the specimens from the White Creek Springs area of Tennessee were found on slopes and bottom lands as float, and their stratigraphic horizon is uncertain. It has been assumed generally that they are derived from the limestones overlying the New Providence equivalent and of approximately Keokuk age, but this is doubtful.

Relationships.—The placement and the differentiation of crinoids with relatively simple structure are difficult. The separation of *Gaulocrinus* from *Stemmatocrinus* is, however, an easy matter on the basis of arm structure alone. *Stemmatocrinus* has long biserial arms. To point out differences between *Gaulocrinus* and species referred to the Permian genus *Calycocrinus* is more difficult, however. Typical *Calycocrinus* has a turbinate cup. The arms are similar to those of *Gaulocrinus*, as for that matter are those of *Edriocrinus* and other widely dissimilar genera. In *Calycocrinus* the articulating face of the radial is narrow, with an indistinct transverse fulcral ridge and a small dorsal ligament pit. There is no platform ventrad and there are no well-defined muscular fossae. The structure is somewhat like that found in such a genus as *Lecanocrinus* and affords some justification for the assignment of *Calycocrinus* to the Flexibilia as now conceived. In *Gaulocrinus* the articulating face is of the type characteristic of many of the heavy-bodied Inadunata. Of what systematic value the articulating faces of the radials may prove to be is a moot point. For our present purposes the striking structural differences shown by the two genera seem sufficient to substantiate the inherently probable wide biologic separation of the two genera.

Species referred to the genus.—

Gaulocrinus bordeni (Springer), n. comb.

Mespilocrinus bordeni Springer, 1920, p. 197, pl. 5, figs. 23a–c: "Knobstone group; Clark County, Indiana" (New Providence).

Gaulocrinus robustus (Troost), n. comb.

Cyathocrinites robustus Troost, 1849, p. 419, *nom. nud.*; 1850, p. 61, *nom. nud.*; 1909, p. 98, pl. 7, figs. 12–14: "Keokuk horizon of the Tullahoma formation. Harpeth River and White's Creek Springs, Davidson County, Tennessee" (Wood). "Harpeth Ridge, Davidson County, Tennessee" (Troost's manuscript locality).

Stemmatocrinus trautscholdi Wachsmuth and Springer (*pars*), Wood, 1909, p. 98.

Gaulocrinus trautscholdi (Wachsmuth and Springer), n. comb.

Stemmatocrinus trautscholdi Wachsmuth and Springer, 1885, pl. 9, figs. 7, 8; 1886, p. 256 (180): "Keokuk limestone near Nashville (White's Creek), Tenn."

Gaulocrinus veryi (Rowley), n. comb.

Stemmatocrinus? veryi Rowley, 1903, p. 133, pl. 38, figs. 7, 8: " . . . probably Keokuk group, of Cumberland County, Kentucky."

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BOTANY.—*Notes on four eastern species of* Gymnosporangium.[1] W. H. LONG, Albuquerque, N. Mex. (Communicated by JOHN A. STEVENSON.)

This paper reports investigations conducted in 1912 and 1913 in the District of Columbia and vicinity, while the author was in the employ of the U. S. Division of Forest Pathology, on the occurrence of four species of *Gymnosporangium*, *G. clavipes* Cke. & Pk., *G. nidus-avis* Thaxt., *G. effusum* Kern, and *G. juniperi-virginianae* Schw.; on the lesions produced by them on the eastern red cedar (*Juniperus virginiana* L.); and on inoculations made with *G. effusum*.

The purpose of these studies was to determine what species of *Gymnosporangium* occurred in the District of Columbia and adjacent areas, their prevalence and distribution, their action on the host, and to ascertain, if possible, the aecial stage of *G. effusum*.

More than 3,000 red cedars were examined for the presence of *Gymnosporangia*, and a record was made of the distribution on each tree of the species found. Data were taken on the extent and character of the lesions produced. Record for each tree was maintained on an individual card showing size and condition of tree, number of lesions on trunk and branches for each species of rust, nature and size of each lesion, and any other pertinent data, such as nearness to aecial hosts if any, for each locality studied. Table 1 gives a summation of these data, showing number of trees examined, number infected, and number of trunk and branch lesions found for each of the four species of *Gymnosporangium*.

The investigations were made during the months of April and May, as the lesions are most conspicuous during these months because of the swelling and gelatinization of the telia. April was very rainy in 1912, with intermittent showers and often with mists and fogs making ideal conditions for the maturation and gelatinization of the telia.

Three of these species of *Gymnosporangium* are perennial in the red cedar while the fourth is biennial. The prevalence of each species for any given area can be determined from the telial stage more accurately than from the aecial since the former is not dependent for its appearance on the climatic factors for each season. A dry year would reduce very materially the aecial stage for that year, but would not affect to any great extent the perennial lesions in the telial hosts.

[1] Received March 9, 1945.

A study of the table shows that 3,040 red cedars were examined, of which 1,206 were attacked by *Gymnosporangium clavipes*, 382 by *G. nidus-avis*, 165 by *G. effusum*, and 76 by *G. juniperi-virginianae*. *G. clavipes* headed the list with 17,030 lesions, *G. nidus-avis* had 1,650, *G. effusum* 408, and *G. juniperi-virginianae* 897, making a total of 19,985 lesions for the four species.

Gymnosporangium clavipes

This species was widely distributed over the areas investigated and was the most abundant as to number of cedars infected and lesions produced. The older and larger cedars were the most heavily infected (see Table 1 for Arlington Cemetery and Catholic University). None of the areas examined was free of this rust, but in some localities it was rare.

G. clavipes was rarely abundant on trees with open tops or with the lower limbs removed for one-half of the distance up the tree, or, strange to say, on solitary trees in the open with many small branches down to the ground. The trees of the last group have a close, dense growth, and this was especially true for trees 2 to 6 inches in diameter. When *G. clavipes* was sparingly present, *G. nidus-avis* and *G. effusum* were usually absent. Cedars that did not have trunk lesions of *G. clavipes* were often so situated that their trunks were not shaded much and had very open foliage. Apparently most of the trunk lesions originated directly on the trunk and did not start on a small branch or twig and thence work down along the trunk.

This rust traveled more rapidly laterally than longitudinally and did not kill the living bark even in the center of the oldest and largest lesions on trunks and large branches, but killed small branches and twigs by girdling and sapping them of their vitality. The yellowish-red telia were small and inconspicuous under the old dead bark of the trunk and were irregularly scattered over the surface of the lesions. All these were well-marked characters of this rust. No lesions were found on very young twigs, but all were on those with well-developed wood and without needles.

Many trunk lesions were found which apparently originated in the enlarged wood at the base of a branch protected by the loose bark at that point. Such lesions did not originate on the branch proper but at its juncture with the trunk and spread from there to the trunk. One of the largest trunk lesions found was 90 cm wide by 40 cm long, with the outer bark very thick, rough, and blackish over the lesion, which was alive throughout. There were numerous trunk lesions on this tree, but there was no evidence that any of them started from branches and then spread to the trunk.

Gymnosporangium clavipes is well recognized as a serious rust on certain varieties of apples, and the abundance of this species over the areas here reported indicates that it would become a serious menace to apple culture during favorable years in these regions.

Gymnosporangium nidus-avis

This *Gymnosporangium* was also found widely distributed over the areas investigated, coming next to *G. clavipes* in number of cedars, infected and lesions produced. Only one area, Park Lane, Va., was free from this species, possibly owing to the small size and youth of the cedars, which were only half an inch to 2 inches in diameter.

Arlington Cemetery and Great Falls, Va., were the most heavily infected areas both in number of trees attacked (301) and lesions (1,418) produced. This heavy infection probably was due to the size of the cedars involved (2 to 45 inches in diameter) and the extreme age of many of them. This rust produces three types of lesions—trunk, branch, and broom. One hundred out of 1,108 branch lesions and 186 of 483 brooms were dead.

The open type of broom with normal needles found about Washington was quite different in aspect and much larger than the dense brooms with juvenile needles found on *Juniperus virginiana* L. var. *crebra* Fernald & Griscom from Massachusetts. In the material examined from Washington and vicinity no telia or lesions were found on young twigs or among the needles, but they were confined to the limbs and branches with heartwood. The living bark down to the sapwood under and adjacent to the telia was stained a golden-yellow during the maturation and gelatinization period. This was a very marked character by means of which the infected area could often be determined even before the telia were formed. This yellow color was due to small yellowish globules in the rust

FIG. 1.—*A*, A typical branch lesion of *Gymnosporangium effusum* with its ridgelike galls extending in parallel lines on the diseased area; *B*, a row of red cedars on the grounds of the Catholic University of America at Washington, D. C., dying from the attacks of three species of *Gymnosporangium*, especially *G. effusum*. Note how many lower branches have died and been removed, and the large black trunk lesions due to *G. effusum*; *C*, closeup view showing more clearly the lesions. Through the kindness of the University authorities, the writer learned that all the trees shown in this figure were dead by 1927, except one which, though still alive, has much dead wood on it.

FIG. 2.—*A*, A row of living expanded telia of *G. effusum*; *B*, cross section of a living gall of *G. effusum* with expanded telia, showing the deep seated character of the lesion; *C*, cross section of a red cedar with three major trunk lesions of *G. effusum*, which have practically killed the tree.

hyphae, which occur in the subhymenial layers beneath the telia. In addition to these yellow globules, many suppressed but apparently mature golden-yellow spores were present, but these were not the main cause of the yellow color. In the Sharon, Mass., material of *G. nidus-avis* no yellow color was found in the substratum beneath the telia.

Some of the brooms around Washington, D. C., were very large, being 58 cm long by 77 cm wide, while trunk lesions ranged from 70 cm long by 9 cm wide to 175 cm long by 42 cm wide. One large branch lesion was 350 cm long on a branch 9 cm in diameter, entirely girdling the dying branch for most of its length.

The material of the dense juvenile-needle brooms studied was obtained from Sharon, Mass., through the kindness of the late Dr. Farlow, while the open type of brooms here discussed was found in the District of Columbia and vicinity.

Gymnosporangium effusum

This species was described by Kern (*5*, pp. 459–460) from material collected by him on the Santee Canal in South Carolina in 1909, but since then very little of importance has appeared in print concerning this *Gymnosporangium*.

Lesions of this rust formed deep-seated, woody-corky, truncate, ridgelike galls, which ran longitudinally in parallel rows on branches and trunks of the red cedar. These galls were 2 to 6 mm tall by 3 to 12 mm wide, with "roots" penetrating to the sapwood of the host (Fig. 2B). These ridgelike galls when alive were composed of rather firm cheeselike tissue filled with rich foodstuffs for the development of the telia. After the teliospores matured the galls became brown, more or less suberized, and covered with a corky callus. After one or possibly two years of fruiting these galls died but persisted for years on the old dead areas of the lesions. These ridgelike galls usually checked transversely into pieces 2 to 15 mm long (Fig. 1A).

The infection spread very slowly transversely on the branches and trunks and the new galls developed at irregular intervals next to and on the outside of the old ones and parallel with them. The telia appeared longitudinally in the ridgelike galls, breaking through the surface callus in slits with only one row of flattened telia to each gall. When expanded the telia were wedge-shaped (Fig. 2A), 10 to 12 mm tall by 2 to 6 mm thick at the top by 10 to 30 mm long, often with ends of the telia confluent for 4 to 6 cm, rugose to dentate on top, sometimes tongue-shaped to cristate, as thick at the bottom as at the top or even thicker, rather firm when fully expanded and often falling away in a body leaving a yellowish scar. The fallen telia had a longitudinal slit extending up into their bases for 1 to 2 mm. Telia when expanded were a light watery brown and about one-third to one-half taller than before gelatinization.

Successive years of fruiting on twigs and branches finally killed the lesions by the complete destruction of the cortex, phloem, and cambium. The old galls became dark brown to blackish with age. The surface of the old lesion on the trunk was usually in a depression covered with the corky ridges of the dead lesions. Very old dead lesions had a charred look like a fire scar (Figs. 1B and 1C) caused by the transverse cracking of the corky ridges and the darkening and partial falling out of the cubes of the diseased dead tissue from weathering.

The trunk lesions gradually killed the live wood, and as these lesions extended very slowly transversely the fungus formed a depression in the trunk, which widened as the tree grew until often only a small amount of live wood tissue was left to nourish the tree (Fig. 2C). The tree was finally killed.

Fig. 2C is a fine example of the action of this *Gymnosporangium* on the tree trunk. This cross section shows three large lesions, which through the years gradually killed nearly all the living tissue of the trunk. One of these lesions was 80 years old, the fungus having entered when the tree was 33 years old. The cross section of another trunk showed a 108-year-old lesion that started when the tree was 20 years old. The fungus at the edges of the lesion, by progressive growth in the adjacent wood, prevented any wound callus from forming, thereby keeping the wound open as shown in Fig. 2C, where the small amount of wood still alive can be noted.

The longitudinal growth of the rust lesion ranged from a maximum of 3 inches to a mini-

mum of 1 inch, having an average of 1.5 inches per year with very little appreciable increase in width. No very young lesions were found, the youngest being 72 cm long by 3½ cm wide. It apparently started on the trunk since no limb was near. Many trunks of red cedars had lesions that were largest at the ground line, then tapered upward, as if the lesion started at or very near the ground. Many branches had been killed by being engulfed and surrounded by adjacent trunk lesions. These dead branches were free of any infection above their bases; hence they could only have been killed by being engulfed. Branches were often flattened by lesions, many of which started on the underside.

This is one of the few rusts in which the length of time the rust has been in the tree can be determined, due to the nature of the lesions that it produces. Trees were found that had been infected for 108 years or longer. Trunk lesions ranged from 22 to 1,050 cm long and of those studied 40 were dead. The number of trunk lesions ranged from 0 to 6 per tree. Branch lesions totaled 173, ranging in length from 15 to 425 cm, and of these 37 were dead.

This is the only *Gymnosporangium* so far as is known that kills the cortex, phloem, and cambium down to the xylem. No study was made on how this killing occurred or the method of lateral spread in the host.

Dodge (*4*) discusses the damage done to *Juniperus virginiana* by *G. nidus-avis*. He divides the lesions produced into two types, the effuse and the caulicolous forms, and on page 106, figure 3, gives photographs of the two types of lesions. His figure 3, A, is a good representation of the caulicolous type of lesions produced by *G. nidus-avis*, showing the irregular orientation of the telia on the lesion, while figures 3, B, and 3, G, given as the effuse form of the above species, are typical examples of the lesions produced by *G. effusum*.

Crowell (*3*, p. 473) claims that *G. effusum* and *G. nidus-avis* are the same species as determined from cultures and microscopic studies of the two species. Apparently the data given and the inoculations made by him were based on the caulicolous form of *G. nidus-avis*. The highly characteristic lesions produced by *G. effusum*, so different from any other *Gymnosporangium*, should make it impossible for this species to be confused with any other.

The alternate stage of *G. effusum* has never been positively determined. Arthur (*1*) reported inoculations made in 1911 on *Aronia arbutifolia*, *Amelanchier canadensis*, *Pyrus communis*, *Malus coronaria*, and *Malus malus*. These sowings produced pycnia on *Aronia arbutifolia* but no aecia ever developed and there was no infection on any of the other hosts inoculated. Arthur (*2*, p. 371) made only one set of cultures of this *Gymnosporangium*. During April and May 1912, the writer made sowings with *G. effusum* from *J. virginiana* on the following species of hosts:

Aronia arbutifolia—10 plants, April 19, 1912, and 5 plants, May 8, 1912.

Aronia nigra—4 plants, April 19, 1912; 2 plants, April 29, 1912; and 2 plants, May 8, 1912.

Amelanchier canadensis—4 plants, April 19 and 29 and May 8, 1912.

Chaenomeles japonica—2 plants, April 10 and 19, 1912.

Cydonia vulgaris—2 plants, April 10 and 19, 1912.

Malus coronaria—3 plants, April 10 and 22, 1912.

Malus malus—2 plants, April 10, 1912.

Pyrus communis—2 plants, April 10 and 19, 1912.

Cerasus arbutifolia—1 plant, April 10, 1912.

No infections developed from any of these sowings.

Recently the writer noted that there are only two species of *Gymnosporangium* whose alternate stages are unknown, *G. effusum* for the aecial and *G. hyalinum* for the telial stage. The type locality of both is South Carolina, and the range of each is much the same along the southern Atlantic coast. There is, therefore, a strong probability that the aecial host of *G. effusum* is one or more of the species of *Crataegus* listed for *G. hyalinum*, viz., *C. clara* Beadle, *C. dispar* Beadle, *C. egens* Beadle, *C. egregia* Beadle, *C. michauxii* Pers., *C. munda* Beadle, *C. pexa* Beadle, *C. quasita* Beadle, *C. viridis* L., and *C. visenda* Beadle. It is rather strange that no one so far as known has made sowings of *G. effusum* on any of these or other species of *Crataegus*. *G. trachysorum*, a closely related species, has its aecial stage on *Crataegus*, which is another indication that this host may contain the aecial stage of *G. effusum*.

Gymnosporangium juniperi-virginianae

This species was not very abundant over the

areas investigated. Only areas with young and small cedars had any appreciable number of trees attacked by it; on those areas where the trees were old and large very few or none were infected. In Arlington Cemetery three galls were found, and only one of these was alive. It seems odd that so few trees of the more than 3,000 examined were infected with this *Gymnosporangium*, which is in marked contrast to the large number attacked by *G. clavipes*. Dead galls as well as living ones were counted, and yet the number found was very small, as shown in the table.

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TABLE 1.—DATA ON GYMNOSPORANGIUM LESIONS ON JUNIPERUS VIRGINIANA FOR EACH AREA INVESTIGATED[1]

Location and diameter of trees	Trees examined	*G. clavipes*			*G. nidus-avis*				*G. effusum*			*G. juniperi-virginianae*		
		Trees infected	Lesions		Trees infected	Lesions			Trees infected	Lesions		Trees infected	Lesions galls	Total lesions
			Trunk	Branch		Trunk	Branch	Brooms		Trunk	Branch			
Arlington Cemetery, 2–45″	555	545	1,730	6,580	169	33	545	433	97	100	80	3	3	9,513
Catholic Univ., 4–28″	93	75	434	1,006	12	4	12	1	33	107	56	0	0	1,620
Roads near Catholic Univ., 16–32″	76	44	40	275	15	1	28	1	22	19	22	0	0	386
Great Falls, Va., 2–6″	405	403	1,697	4,050	132	16	356	45	7	5	2	2	15	6,186
Park Lane, Va., ½–2″	383	4	0	20	0	0	0	0	0	0	0	0	0	20
Fences near Park Lane, 4–12″	388	29	32	119	10	3	33	0	0	0	0	6	63	250
Franklin Park, 2–14″	174	14	42	70	3	0	10	0	0	0	0	36	615	737
Country Club, 4–20″	116	30	200	464	11	1	35	0	0	0	0	1	20	720
El Nido to Franklin Park, 6–14″	49	40	60	115	2	0	4	0	1	0	1	6	40	220
Fence rows, 3–16″	503	7	0	33	14	0	43	4	1	0	1	22	141	222
Scattered trees, 6–12″	298	15	3	60	14	0	42	0	4	4	2	0	0	111
Totals	3,040	1,206	4,238	12,792	382	58	1,108	484	165	235	173	76	897	19,985

[1] Many of the cedars in Arlington Cemetery were being seriously damaged in 1912 by three other enemies in addition to the rusts: a climbing grape vine (*Vitis* sp.) had overrun 75 of them, killing 38; 51 of the trees had poison-ivy (*Rhus toxicodendron*) on trunks and lower branches; while 102 had a butt rot (*Fomes subroseus*), which was destroying the heartwood, thereby weakening the trees.

ENTOMOLOGY.—*Three new species of* Laminitarsus *Fullaway from Singapore and the Philippines (Hymenoptera: Braconidae).*[1] YING-TOU MAO, University of California. (Communicated by C. F. W. MUESEBECK.)

In the course of revising the North American species of the hymenopterous subfamily Cardiochilinae the author found three interesting species of *Laminitarsus* Fullaway in the Baker collection at the U. S. National Museum. The genus *Laminitarsus* was first established in 1919 by Fullaway to include only one species from Los Baños, Luzon, Philippine Islands. He placed it in the subfamily Cardiochilinae without further statement.

The species of both *Cardiochiles* Nees and *Laminitarsus* Fullaway have the third abscissa of the radius arched basally, but *Laminitarsus* may be easily recognized by the extraordinarily broadened and lengthened basitarsus of the posterior leg (Figs. 6, 7, 8) and the more or less triangular propodeum.

Four species of *Laminitarsus* are now known and they may be distinguished as follows:

1. Occiput deeply excavated and temple conspicuously bulging posteriorly; second segment of hind tarsus joined apically to basitarsus.....2
   Occiput shallowly excavated and temple not bulging much posteriorly; second segment of hind tarsus joined ventrally to basitarsus. *singaporensis*, n. sp.
2. Wings infumated.....*muiri* Fullaway[2]
   Wings hyaline, with only apical fifth of forewing and tip of hind wing infumated.....3
3. Face rugose; basitarsus of hind leg about twice as long as remaining four tarsal segments combined.....*rudis*, n. sp.
   Face smooth; basitarsus of hind leg about one-third longer than remaining four tarsal segments combined.....*chapini*, n. sp.

Laminitarsus chapini, n. sp.

Female.—Length 6.2 mm. Body yellowish brown with the following parts black: Antenna except scape and pedicel, vertex, frons medially, clypeus apically, mesoscutum except anterolateral corner, mesopleuron except dorsally and posteriorly, pectus, base of middle tibia, middle tarsus, two spots on outer surface of hind coxa, hind trochanters, hind femur except apex, hind tibia basally, ventrally, and apically, hind tibial spurs basally, hind basitarsus except medially, the remaining four tarsal segments, a spot on each side of second tergite and apical half of tergites 3 to 5. Fore tarsus except base, spurs of middle tibia, spurs of hind tibia apically, and ovipositor sheath dark brown; wings with apical fifth light fuliginous and the rest hyaline; veins dark.

HEAD: Antenna 41-segmented; scape and pedicel with longer pubescence than the flagellum; eye bare; ocelli slightly elevated; vertex smooth, shining, and slightly sloping towards frons; occiput excavated; frons smooth, shining, impressed, and with a median longitudinal carina; face smooth, shining, and with a short median ridge at upper third; clypeus plain, smooth, shining, and not notched at the median apical margin; maxillary palpus prominent and longer than the head; temple narrower than the eye in dorsal view and bulging posteriorly; galea short.

THORAX: Lateral face of pronotum rugose on posterior half; median lobe of mesoscutum plain; notaulices distinct and foveolate; mesopleuron smooth and shining, upper groove weakly foveolate, lower groove foveolate and its lower margin flattened, posterior groove foveolate with a smooth depression at the middle anteriorly; metapleuron rugose, median ventral part of its anterior portion smooth and shining, and the posterior margin of its posterior portion flaring; propodeum rugose, pleural carina high and distinct, areola long, flat and indistinct, spiracular area acute posteriorly, spiracle long ovate. First abscissa of radius longer and thicker than that of basal vein; second abscissa of radius slightly less than three times as long as first; third abscissa of cubitus longer than fourth; second abscissa of cubitus shorter than recurrent vein (Fig. 3); interanal vein absent. Second and fifth segments of fore tarsus about equal; inner spur of middle tarsus about as long as basitarsus, second and fifth tarsal segments about equal; hind tibia flattened and broadened apically, tibial spur about as long as the second to fifth tarsal

[1] Received March 3, 1945.

[2] Journ. Straits Branch Roy. Asiat. Soc., no. 80: 57–58, fig. 3, ♀. 1919.

segments combined, basitarsus long, broad, and flattened, about two thirds as long as the tibia, the remaining four tarsal segments combined about three-fourths as long as the basitarsus, second tarsal segment thickened, longer than the fifth and apically joined to the basitarsus (Fig. 7); hind tarsal claws pectinate basally.

ABDOMEN: First abdominal suture extending obliquely forward from the sides of the median elevation of first tergite; second and third tergites medially of about equal length; hypopygium about as long as the third tergite, obtuse in profile; ovipositor sheath inconspicuous, pubescent, about half as long as the hypopygium.

Type.—Female, Iligan, Mindanao, Philippine Islands, C. F. Baker, U.S.N.M. no. 57270. This species is named in honor of Dr. E. A. Chapin, curator of insects, U. S. National Museum.

Laminitarsus rudis, n. sp.

Female.—Length 6.5 mm. Yellowish brown, the following parts black: Antenna except scape lateroanteriorly and pedicle apically, a transverse band taking in posterior part of vertex and upper part of occiput, ocellar area, frons medially, three broad longitudinal vittae on mesoscutum, mesopleuron except dorsal third, pectus, middle trochanters apically, middle tibia basally, middle tarsus except base, one spot on hind coxa dorsoapically, hind trochanters, hind femur basally, hind tarsus except base, and a transverse band on each tergite from third to seventh. Apex of hind tibia, and hind tibial spurs infuscated; wings hyaline and veins dark, forewing with apical fifth, and hind wing apically, light fuliginous.

HEAD: Antenna incomplete; scape and pedicle with pubescence about as long as the flagellum; eye bare; ocelli slightly elevated, the distance between the posterior pair about twice as long as that between either one of these and the anterior ocellus; vertex punctate and shining; occiput excavated; frons punctate, shining, with a low median longitudinal carina; face rugose, with a short median ridge at about upper third; clypeus punctate, not notched medially on apical margin; temple and eye about equal in dorsal view; maxillary palpus prominent, about as long as the head; galea short.

THORAX: Lateral face of pronotum rugose on posterior half; mesoscutum punctate, its median lobe plain; notaulices distinct, foveolate, and flat in the posterior angle; mesoscutellum punctate; upper groove of mesopleuron finely rugose, lower groove broad, punctate and flat on ventral part, and posterior groove foveolate with a smooth groove at the middle leading anteriorly to the lower groove; metapleuron rugose, its posterior margin flaring; propodeum rugose, its pleural carina high and distinct, its aerolar carina represented by a short stump posteriorly, its spiracular carina not distinct, and its spiracle long ovate. First abscissa of radius equal to that of basal vein but thicker, and about one-fourth as long as the second abscissa of radius; third abscissa of cubitus longer than the fourth; second abscissa of cubitus and recurrent vein equal (Fig. 4); interanal vein absent. Second and fifth segments of fore tarsus about equal; inner spur of middle tibia slightly shorter than the basitarsus and second and fifth tarsal segments about equal; hind tibia flattened and broadened toward apex, its inner spur longer than the second to fifth tarsal segments combined; basitarsus enormously developed, broadened, flattened, and slightly more than two-thirds as long as the tibia; the other four tarsal segments combined about half as long as the basitarsus, second and fifth segments about equal; hind tarsal claws pectinate basally.

ABDOMEN: First abdominal suture extending obliquely forward at the sides; second and third tergites of about equal length medially; hypopygium about as long as the third tergite and obtuse in profile; ovipositor sheath inconspicuous, about half as long as the hypopygium, and pubescent.

Type.—Female, Island of Basilan, Philippine Islands, C. F. Baker, U.S.N.M., no. 57271.

Laminitarsus singaporensis, n. sp.

Female.—Length 5 mm. Head and thorax yellowish brown; antenna, occiput, vertex, face medially, tip of mandible, lower half of proepisternum, mesopleuron, pectus, and anterior portion of metapleuron black. Mesoscutum black with anterolateral vitta of median lobe, and anterior end and a narrow vitta of lateral lobe laterad of the posterior half of the notaulix yellowish brown. Wings hyaline, apical fifth of forewing and tip of hind wing infumated. Legs yellowish brown, middle leg with

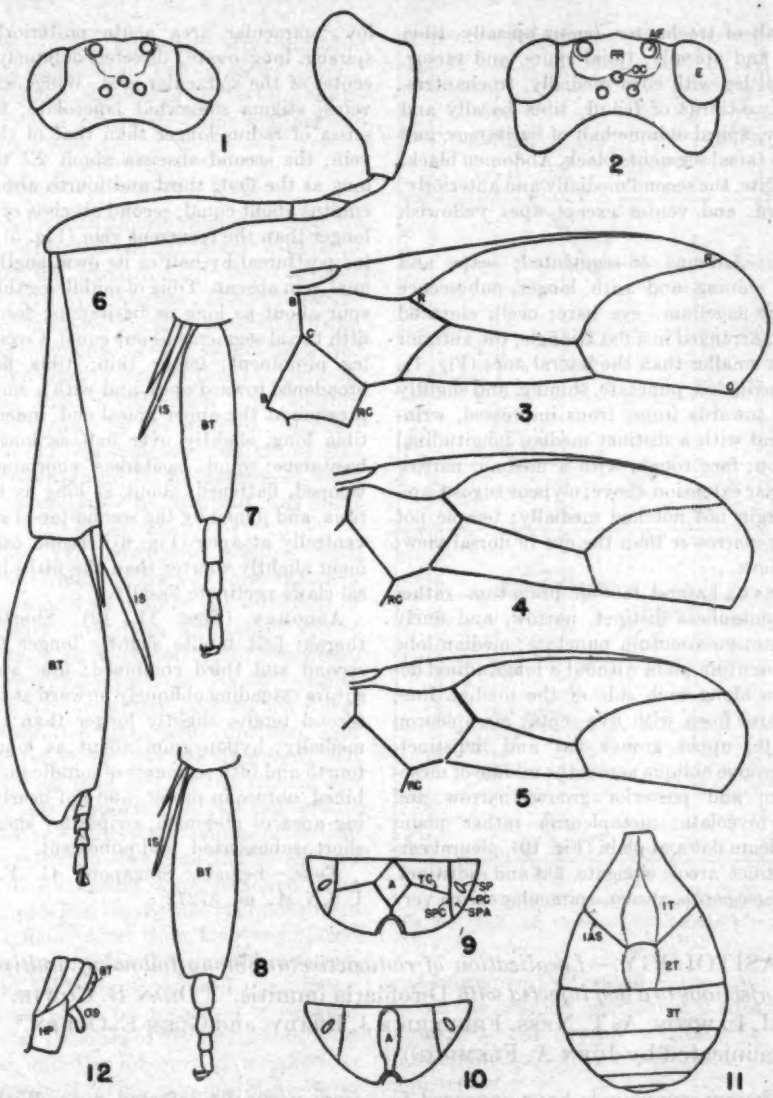

FIG. 1.—Head of *singaporensis* (dorsal view). FIG. 2.—Head of *chapini* (dorsal view) (similar to *rudis*). FIG. 3.—Part of forewing of *chapini* showing radius and cubitus. FIG. 4.—Part of forewing of *rudis* showing radius and cubitus. FIG. 5.—Part of forewing of *singaporensis* showing radius and cubitus. FIG. 6.—Left hind leg of *singaporensis* (ventral view). FIG. 7.—Part of hind leg of *chapini* showing tibial spurs and tarsus. FIG. 8.—Part of hind leg of *rudis* showing tibial spurs and tarsus. FIG. 9.—Typical propodeum of *Cardiochiles* Nees. FIG. 10.—Propodeum of *Laminitarsus* Fullaway. FIG. 11.—Abdomen of *singaporensis* (dorsal view) (similar to *chapini* and *rudis*). FIG. 12.—Part of abdomen of *singaporensis* showing hypopygium and ovipositor sheath (similar to *chapini* and *rudis*).

All figures are proportionally drawn. A, areola; AF, antennal foramen; B-B, basal vein; BT, basitarsus; C-C, cubitus; E, eye; FR, frons; HP, hypopygium; IS, inner spur; OC, ocelli; OS, ovipositor sheath; PC, pleural carina; RC, recurrent vein; R-R, radius; SP, spiracle; SPA, spiracular area; SPC, spiracular carina; ST, stigma; TC, transverse carina; IAS, first abdominal suture; 1T, first tergite; 2T, second tergite; 3T, third tergite; 8T, eighth tergite.

basal half of trochanter, femur apically, tibia basally and apically, tibial spurs, and tarsus, and hind leg with coxa medially, trochanters, apical two-thirds of femur, tibia basally and medially, apical oblique half of basitarsus, and last two tarsal segments black. Abdomen black, first tergite, the second medially and anteriorly, the third, and venter except apex yellowish brown.

HEAD: Antenna 48-segmented; scape and pedicel shining and with longer pubescence than the flagellum; eye bare; ocelli elevated slightly, arranged in a flat triangle, the anterior member smaller than the lateral ones (Fig. 1); vertex wrinkled, punctate, shining, and slightly sloping towards frons; frons impressed, wrinkled, and with a distinct median longitudinal elevation; face rough, with a median, narrow triangular extension above; clypeus rugose, apical margin not notched medially; temple not bulging, narrower than the eye in dorsal view; galea short.

THORAX: Lateral face of pronotum rather plain; notaulices distinct, narrow, and finely foveolate; mesoscutum punctate; median lobe of mesoscutum plain without a longitudinal depression along each side of the median line; transverse fossa with five septa; mesopleuron punctate, upper groove flat and indistinct, lower groove oblique across the middle of mesopleuron, and posterior groove narrow and finely foveolate; metapleuron rather plain; propodeum flat and plain (Fig. 10), pleural carina distinct, areola elongate, flat and indistinct, transverse carina absent, spiracular carina very low, spiracular area acute posteriorly, and spiracle long ovate, directed obliquely in the center of the spiracular area. Wings with thin veins; stigma somewhat lanceolate; first abscissa of radius longer than that of the basal vein; the second abscissa about 2.5 times as long as the first; third and fourth abscissae of cubitus about equal; second abscissa of cubitus longer than the recurrent vein (Fig. 5); nervulus postfurcal by half of its own length; interanal vein absent. Tibia of middle leg thin, inner spur about as long as basitarsus; second and fifth tarsal segments about equal. Coxa of hind leg prominent; femur thin; tibia flattened, broadened toward apex, and with a smooth depression at the upper apical end; inner spur of tibia long, slightly over half as long as the basitarsus; hind basitarsus enormously developed, flattened, about as long as the hind tibia, and joined by the second tarsal segments ventrally at apex (Fig. 6); second tarsal segment slightly shorter than the fifth; hind tarsal claws pectinate basally.

ABDOMEN (Figs. 11, 12): Shorter than thorax; first tergite slightly longer than the second and third combined; first abdominal suture extending obliquely forward at the sides; second tergite slightly longer than the third medially; hypopygium about as long as the fourth and fifth segments of middle tarsus combined, obtuse in profile, and not nearly attaining apex of abdomen; ovipositor sheath very short, subexserted, and pubescent.

Type.—Female, Singapore, C. F. Baker, U.S.N.M., no. 57272.

PARASITOLOGY.—*Localization of radioactive antimony following multiple daily injections to a dog infected with* Dirofilaria immitis.[1] DEAN B. COWIE, ALFRED H. LAWTON, A. T. NESS, FREDERICK J. BRADY, and GLEN E. OGDEN.[2] (Communicated by JOHN A. FLEMING.)

Antimony compounds have appeared to offer the most promise in the treatment of human filarid infections. In our studies it was found (1) that daily injections of several such compounds were effective in eradicating microfilariae of *Dirofilaria immitis* from naturally infected dogs. With regard to the fate of antimony in the tissues, we have reported (2) the distribution of radioactive antimony following a single intravenous administration of tartar emetic, sodium antimonyl xylitol, and an aqueous suspension of antimony trioxide. Since multiple daily injections of compounds at the dosage level of 0.8 milligram of antimony per kilogram of body weight were used in the experimental treatments, a knowledge

[1] Received March 16, 1945.

[2] From the Department of Terrestrial Magnetism of the Carnegie Institution of Washington and the Laboratories of Zoology, Chemistry, and Industrial Hygiene Research, National Institute of Health.

of the fate of the antimony after multiple injections was desired. In this paper a study with repeated injections of sodium antimonyl xylitol prepared from radioactive antimony is reported.

EXPERIMENTAL PROCEDURE

Radioactive antimony was prepared by the bombardment of antimony with deuterons in the cyclotron of the Carnegie Institution of Washington. The radioactive antimony was chemically separated from the other elements of the target and was recovered as nearly pure antimony trioxide. This was then synthesized into sodium antimonyl xylitol by the method described elsewhere (1). An aqueous solution of this chemical containing 10 milligrams of antimony per milliliter of solution was used throughout the experiment.

Dog no. 148 naturally infected with *Dirofilaria immitis* was given intravenously 0.8 milligram of antimony per kilogram of body weight as sodium antimonyl xylitol solution daily, except Sunday, for two weeks or a total of 12 injections. Blood samples were drawn immediately before each injection, 15 minutes after each injection, and 36 hours following the last injection. To these blood samples dry sodium citrate was added in the proportion of 10 milligrams per milliliter. Thirty-six hours after the last injection the dog was sacrificed and samples of 35 tissues were removed. The blood samples and the tissue specimens were weighed quickly after their removal, placed in a desiccator containing phosphorus pentoxide, and kept under reduced pressure at room temperature by means of a vacuum pump. After 16 hours of drying, tissues were reweighed and the amount of weight loss was determined. The samples were then ground in a mortar to a more or less homogeneous state.

Determinations of the antimony content of the blood and other tissues were made by measuring the number of disintegrations per second per unit weight of tissue powder with a Geiger-Müller counter and comparing this with a known standard. The standards were prepared by adding a known amount of the radioactive antimony to a sample of normal blood which

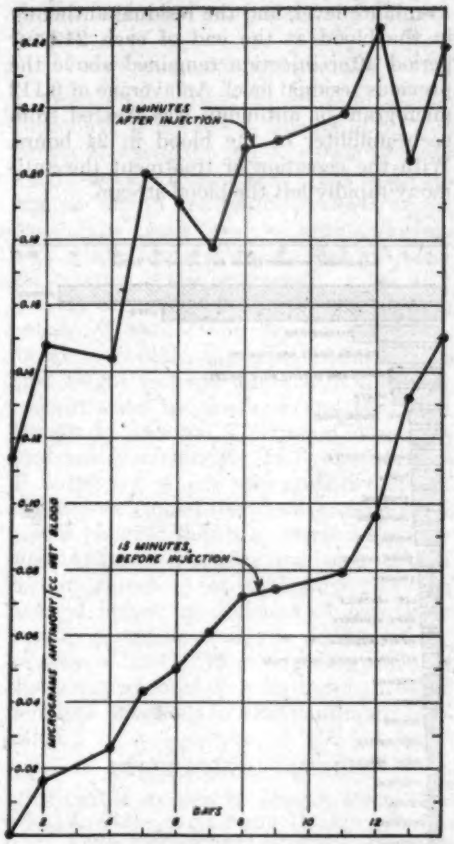

FIG. 1.—Antimony concentration in blood of dog no. 148, 15 minutes before and after injection.

was subsequently treated in the same manner as the samples containing the unknown quantities. An overall accuracy in these determinations of ± 1 per cent was demonstrated.

Microfilarial counts were made daily by a previously described method (3).

RESULTS

Figure 1 shows the blood content of antimony before each injection and 15 minutes after each injection. The antimony content is expressed in micrograms per gram of wet weight of blood. It will be noted that each injection causes the 15-minute postinjection level to exceed the previous

15-minute level, and the residual antimony in the blood at the end of each 24-hour period after injection remained above the previous residual level. An average of 0.112 microgram of antimony was cleared from each milliliter of the blood in 24 hours. With the cessation of treatment the antimony rapidly left the blood stream.

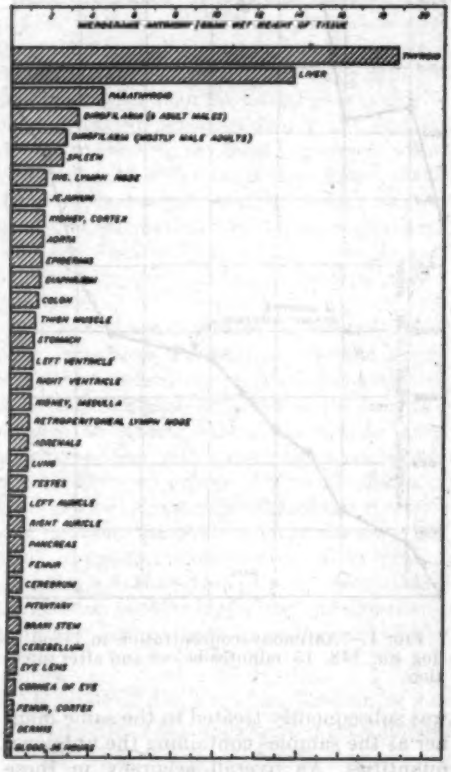

FIG. 2.—Antimony concentration in tissues of dog no. 148, 36 hours after last injection.

The dog in question became free of microfilariae after nine injections given over a 10-day period. Six live adult male *Dirofilaria immitis* were found in the right ventricle at autopsy. No live female parasites were recovered, but numerous fragments of recently dead and degenerated worms were removed from the pulmonary arterial tree. No other abnormalities were observed.

The antimony concentration of 35 tissues taken from this dog (no. 148) at autopsy 36 hours after the last treatment is given in Fig. 2 as micrograms per gram of wet weight of tissue. A wide variation in concentration values was recorded for the various tissues, ranging from 18.72 to 0.29 micrograms per gram of tissue. The thyroid gland had the greatest concentration of antimony. The liver also had a high antimony concentration, since each gram contained 13.75 micrograms. The parathyroid glands with 4.49, the filarids with 3.28, and the spleen with 2.60 micrograms of antimony per gram of wet weight were all higher than the highest blood level recorded in this experiment. It may be assumed that these tissues have a specific affinity for antimony. The other tissues are listed in the figure in the order of their antimony concentration.

DISCUSSION

In a previous paper (2) determination of the antimony in the blood after a single injection of tartar emetic and sodium antimonyl xylitol showed that there was an initial rapid decrease of the element during the first hour after injection followed by a slow removal for the next 4 to 16 hours with a slight secondary rise in the blood level at 24 to 36 hours. Of even more importance is the fact that the present experiment demonstrates continuous accumulation of the antimony in the blood. Parallel rates of accumulation are seen both 15 minutes and 24 hours after the injections. This shows that the repeated injection of 0.8 milligram of antimony per kilogram of body weight results in an accumulation of the element in the blood and that this dosage exceeds the clearance rate. Such a result adds support to the hypothesis (1) that a certain threshold of antimony must be reached before beneficial therapeutic results can be obtained. During the 24 hours preceding the elimination of circulating microfilariae, the highest recorded blood concentration was 0.218 microgram and the lowest was 0.096 microgram per gram of blood.

The irregularity of the curve showing the antimony level of the blood samples 15 minutes after treatment can be explained

on the basis that the rate of change was so rapid that an error of a minute or two in drawing the blood was reflected in the considerable change in the antimony level. In the case of the specimens taken 24 hours after the injection a time error of a minute or two made little difference in the results.

After single injections of tartar emetic, sodium antimonyl xylitol, or antimony trioxide, the liver contained the largest concentration of antimony. The thyroid and parathyroid tissues contained the next largest concentration and the adult *Dirofilaria immitis* ranked third. After 12 injections of sodium antimonyl xylitol, at the same dosage level as with the single injections, the thyroid gland contained the highest concentration of antimony, the liver was now second in antimony concentration, and the adult filarids remained third. A possible explanation for this reversal of the relative ranking of the thyroid gland and the liver is that the thyroid may continue its specific uptake of antimony whereas the liver may reach a point of equilibrium more quickly and the uptake and discharge of the antimony from the hepatic tissue may become equalized. In this way the thyroid gland finally exceeded the liver in the amount of antimony contained per gram of wet tissue.

There was an accumulation of antimony in all of the tissues studied and such tissues contained more antimony per gram of wet weight following multiple daily injections than they did following a single injection.

The finding of an element that is not known to enter into normal metabolic processes, such as antimony, in large quantities, in the thyroid gland was unexpected. These studies are being broadened so as to determine the relationship of this finding to the toxicology and therapeutic usefulness of antimony and other therapeutically active elements. This specific activity of the thyroid gland forms a broad basis for further studies in general physiology and pharmacology.

SUMMARY AND CONCLUSIONS

Twelve intravenous injections of sodium antimonyl xylitol in the amount of 0.8 milligram of antimony per kilogram of body weight daily, except Sunday, led to a continuous rise in the antimony level of the blood. The tissue levels of antimony were higher than those recorded following a single injection of this compound.

With the multiple injections of sodium antimonyl xylitol, the thyroid gland was found to contain the most antimony per unit weight and was followed in antimony concentration by the liver and the adult *Dirofilaria immitis*. Thirty-two other tissues showed a relatively small concentration of antimony, which was probably not of significance from a therapeutic standpoint.

It is believed that the observed accumulation phenomena offer evidence that a certain threshold of antimony must be reached before microfilariae of *Dirofilaria immitis* disappear from the peripheral circulation of infected dogs. It seems probable that a similar conclusion may apply in other helminth infections in which antimony is of value.

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GEOLOGICAL SOCIETY

618TH MEETING

The 618th meeting of the Society was held at the Cosmos Club, January 12, 1944, President GEORGE TUNELL presiding.

Informal communications.—W. T. SCHALLER reported the discovery of a new mineral, a hydrous potassium calcium silicate, which he named miserite.

Program.—MARIE L. LINDBERG: *Heavy mineral correlation of the Fox Hills, Hell Creek, and Cannonball sediments, North Dakota.* A study of sediments along the Cannonball and Missouri Rivers, N. Dak., was made to correlate exposures of Fox Hills, Hell Creek, and Cannonball formations. Nine heavy mineral zones were established. In the Fox Hills formation, three heavy mineral zones correspond to three lithologic units: Zone 1, a thick-bedded yellowish-brown sandstone is characterized by an average amphibole content of 41 percent of the non-opaque heavy minerals; zone 2, an olive-colored sandy, banded shale contains 22 percent amphibole; zone 3, a gray-white sandstone increases in amphibole content to 66 percent. Zone 3 extends to the base of the Breien marine member of the Hell Creek. Zones 4 through 8 belong to the Hell Creek formation. Along the Missouri River, zone 4 is below the first bentonitic bed; zones 6 and 7 are superimposed. In the Cannonball River sections, zone 4, a fine-grained, badly weathered sand, is the lowest bed in the Breien; zone 6, a fine-grained to silty, grey-green sand begins in the Breien and extends into continental Hell Creek. Zones 5 and 8 are local. Zone 7 extends through upper Hell Creek to the top of the Ludlow. In zone 4, the amphibole content is 21 percent; epidote is 38 percent; and garnet is 16 percent. In zone 6 the amphiboles decrease to 7 percent; epidote is 40 percent; garnet is 23 percent. In zone 7 amphiboles are 4 percent; epidote increases to 51 percent; and garnet decreases to 15 percent. There is a marked change in heavy mineral content at the base of the Cannonball. Amphiboles increase to 55 percent in zone 9.

J. S. WILLIAMS: *Principal fluorspar deposits of the United States.*

J. B. MERTIE: *Piezoelectricity, with special reference to quartz.*

619TH MEETING

The 619th meeting of the Society was held at the Cosmos Club, February 9, 1944, President GEORGE TUNELL presiding.

Program.—G. D. ROBINSON: *The molybdenite deposit at Shakan, Alaska.* The molybdenite deposit near Shakan on Kosciusko Island, southeastern Alaska, is in a narrow, low-dipping fault zone, constituting a composite vein, in hornblende diorite. Breccia blocks of hornblende diorite are the principal vein filling. The diorite fragments are separated and locally replaced along the margins by bands and small irregular masses of igneous and hydrothermal materials, introduced at various times during repeated reopenings of the fault zone, and by silicified gouge. Included in the introduced matrix are granite pegmatite; quartz-adularia, quartz, and calcite veins; lamprophyre and aplite dikes; zeolite encrustations; and pyrite, pyrrhotite, chalcopyrite, sphalerite, and molybdenite.

Inconclusive evidence indicates that the distribution of molybdenite was controlled principally by openings developed in the steeper dipping parts of the fault zone as a consequence of small-scale normal faulting.

Surface and underground workings expose one ore shoot of moderate tonnage containing about 1.5 percent MoS_2. Additional ore shoots may be present in other relatively steep dipping parts of the zone not now exposed.

The introduced vein materials appear to have been deposited over a wide range of temperature but at relatively low pressure. Molybdenite was deposited near the end of the mineralization sequence. The deposit does not fit readily into the Lindgren classification; it is perhaps best grouped with the zenothermal type of Buddington.

W. H. HASS: *Conodont morphology.* Spectrographic and petrographic data on conodonts obtained through a study of collections from two Ordovician, seven Mississippian, and two Pennsylvanian formations permitted the following conclusions: (a) the conodonts studied are composed of a fluorian dahllite, a member of the dahllite-francolite isomorphous series of apatite minerals; (b) each lamella of a conodont is composed of innumerable dahllite crystals; and (c) the *c*-axis of each dahllite crystal

is invariably oriented in the direction in which the main ontogenetic growth occurred at the place in the lamella where the crystal is located. The data will be described and published in an article entitled *Orientation of the crystal units of conodonts*, by WILBERT H. HASS and MARIE L. LINDBERG.

P. B. KING: *Tectonics of northeasternmost Tennessee.* The three northeasternmost Tennessee counties lie in the Appalachian province. Their rocks are strongly deformed, and the area is outstanding for its display of large-scale overthrusting in the pre-Cambrian, Cambrian, and Ordovician rocks.

This paper is an outgrowth of recent investigations of manganese deposits of the area. Part of the investigation consists of mapping extensive areas, one product of which was a reasonably comprehensive new picture of the structural features of the region.

This newer picture resembles that presented by Keith in folios of the Geological Survey, but there are modifications of the details. Movement along the Iron Mountain fault, which dips northwest, was interpreted in the folios as having been to the southeastward. However, distribution of rock facies, the nature of minor structural features, and other evidence indicates that the movement was actually northwestward. This implies much greater movement of thrust sheets to the northwest than was originally believed. The rocks to the northwest and above the Iron Mountain fault are now interpreted as belonging to the Shady Valley thrust sheet, and the rocks to the southeast and below it as belonging to the Mountain City window. Resting on the Shady Valley thrust sheet, as first recognized by Keith, is the still higher Bald Mountain thrust sheet.

The pattern of the overthrust faults is complicated by many tear faults, some of great length and displacement, which had not been recognized before the present investigation.

620TH MEETING

The 620th meeting of the Society was held at the Cosmos Club, March 8, 1944, President GEORGE TUNELL presiding.

Program—L. A. WARNER: *Magnetite deposits of Kasaan Peninsula, southeastern Alaska.* High-grade deposits of magnetite, containing some copper, on Kasaan Peninsula, Prince of Wales Island, southeastern Alaska, lie within a mile of salt water at altitudes of less than 1,500 feet.

The deposits have been worked intermittently since 1900, principally for their copper content, and have yielded more than 600,000 tons of ore valued at more than $6,000,000.

The ore consists chiefly of magnetite with pyrite and chalcopyrite. The ratio of chalcopyrite to magnetite ranges widely, and locally the deposits are chiefly copper ore with minor amounts of precious metals. The major reserves, however, are in iron ore and in the bodies examined the reserves are estimated to exceed 5,000,000 tons. The average ore tenor is about 50 percent iron and 0.5 percent copper. Phosphorus and titanium are virtually absent. The sulphur content ranges from a few hundredths of a percent to about 4 percent.

In 1942 the Geological Survey resumed a systematic study of the deposits which is still in progress. Topographic, magnetic, and geologic surveys have been made at most of the deposits which have been mined or prospected.

Some trenching, sampling, and diamond drilling have been carried on by the Bureau of Mines. Much of the peninsula has been only superficially prospected and it is anticipated that further work will reveal additional ore bodies.

R. H. JAHNS: *The Harding beryllium-tantalum-lithium pegmatites, Taos County, N. Mex.*

W. T. THOM, JR.: *The structural evolution of the Big Horn Basin.*

621ST MEETING

The 621st meeting of the Society was held at the Cosmos Club, March 22, 1944, President GEORGE TUNELL presiding.

Informal communications.—L. HENBEST discussed the lighting of specimens for photography.

Program.—W. M. CADY: *Stratigraphy and structure of west-central Vermont.*

G. T. FAUST and E. CALLAGHAN: *Mineralogy and petrology of the Currant Creek magnesite district, Nevada.*

W. H. BRADLEY, K. E. LOHMAN, and A. H. FRAZIER: *A machine for obtaining true perspective diagrams from maps.*

622D MEETING

The 622d meeting of the Society was held at the Cosmos Club, April 12, 1944, President GEORGE TUNELL presiding.

Program.—V. T. ALLEN: *Sedimentary and volcanic processes in the formation of high-alumina clays.* Along the Pacific coast, where volcanic materials predominate, the importance of sedimentary processes in the formation of high-alumina clays has not been fully appreciated. At Ione, Calif., Castle Rock, Wash., Whiteware, Mont., Hobart Butte and Molalla, Oreg., where the Geological Survey has been investigating clays jointly with the U. S. Bureau of Mines, sedimentary processes have been more important in the formation of high-alumina clays than have volcanic processes. Clays derived directly from volcanic materials are composed dominantly of montmorillonite; but these clays, with the exception of the beidellite-nontronite varieties, have relatively low percentages of available alumina. In contrast, clays derived by thorough leaching of various aluminous rocks under conditions favoring thorough drainage are composed dominantly of kaolinite and when sorted by sedimentary processes form high-grade deposits; furthermore, the depositional structures of these sedimentary clays have favored the derivation of gibbsite through weathering or the formation of dickite or kaolinite through hydrothermal action. Kaolinite, gibbsite, and dickite all have relatively high percentages of available alumina. The iron-bearing minerals in these deposits, arranged in the order of their importance, include: siderite, hematite, limonite, nontronite, pyrite, ilmenite, vivianite, celadonite, and scorodite.

S. E. CLABAUGH: *Paragenesis of the tungsten ore of the Ima mine, Idaho.* The Ima mine in the Blue Wing district is the second most important producer of tungsten in Idaho, and the quartz veins of the district constitute the largest of the known huebnerite deposits of the Western States. Workings of the Ima mine extend from Patterson Canyon northwestward for a distance of about half a mile, and the extent of the Ima vein system is presumably much greater. The productive veins occupy normal faults of small displacement in quartzite and granite. The quartzite is metamorphosed impure sandstone considered to be part of the Belt series. Granite is exposed only in the underground workings.

Closely associated with the granite are irregular bodies of pegmatite and orthoclase-bearing veins which contain mica, pyrite, and molybdenite. The pegmatite and feldspar-bearing veins are cut by the more persistent main veins which contain the economically important tungsten, silver, copper, and lead minerals.

Most of the ore shows prominent banding which is attributed to repeated fracturing or reopening of the veins during mineralization. Unbanded parts of the vein material near the granite contact contain large crystals of pyrite, fluorite, and huebnerite. Banded ore contains the same minerals plus rhodochrosite, tetrahedrite, sphalerite, galena, and chalcopyrite. The general sequence of minerals is as follows: orthoclase, quartz, and mica followed by pyrite and molybdenite in the early veins; quartz, fluorite, pyrite, and huebnerite in the unbanded ore, followed by quartz, rhodochrosite, huebnerite, sphalerite, and finally quartz, fluorite, tetrahedrite, galena, and chalcopyrite in the banded. Scheelite occurs in small seams along fractures and replaces shattered huebnerite.

J. D. H. DONNAY: *Twinning, isomorphism, and epitaxy.*

623D MEETING

The 623d meeting of the Society was held at the Cosmos Club, November 8, 1944, President GEORGE TUNELL presiding.

A memorial to E. O. ULRICH was read before the Society by J. B. REESIDE, JR. (Published in this JOURNAL 34 (5): 168. 1944.)

A memorial to ARTHUR KEITH was spoken by N. H. DARTON. (Published in this JOURNAL 34 (7): 240. 1944.)

A memorial to GEORGE STEIGER was read by J. J. FAHEY. (Published in this JOURNAL 34 (10): 347. 1944.)

A memorial to ROGER C. WELLS was read by W. T. Schaller. (Published in this JOURNAL 34 (10): 348. 1944.)

Program.—H. R. GAULT: *Geology and zinc deposits in the Groundhog and Glacier Basins, Wrangell district, southeastern Alaska.* Groundhog and Glacier Basins are on the mainland of southeastern Alaska about 13 miles east of Wrangell.

The zinc deposits are in a sequence of schists and gneisses which are part of a belt of metamorphic rocks bordering the west side of the Coast Range batholith for many miles. The schists and gneisses in Groundhog and Glacier Basins are bounded on the west by a large sill-like mass of quartz diorite.

Bedding and cleavage of the metamorphic rocks are about parallel. The regional strike is N. 25° W. and the general dip is 60° N.E.

Many quartz porphyry sills and dikes cut the metamorphic rocks and the sill-like quartz diorite. Quartz-fluorite breccia veins occupy many faults and fractures and are younger than the quartz porphyry sills. Basalt sills and dikes are widespread and are younger than the veins.

Breccias, made up of fragments of metamorphic rocks and quartz porphyry, occur as sills and dikes and as large irregular masses in the metamorphic rocks.

The zinc deposits are pyroxene granulite beds that have been replaced by sphalerite, galena, and pyrrhotite and minor amounts of other sulfide minerals. Two types of ore are recognized, a solid-sulphide type and a disseminated-sulphide type. Significant amounts of ore of the solid-sulphide type crop out only in Groundhog Basin. Ore beds containing only disseminated ore crop out on the north slope of Glacier Basin and at higher altitudes to the north toward Groundhog Basin grade into and are interbedded with barren pyroxene gneiss.

The most westerly ore bed in Glacier Basin is correlated with the lowest bed in Groundhog Basin.

The total known extent of zinc metallization in the pyroxene granulite beds is about three miles through a vertical range of about 3,000 feet. The best ore in both basins is exposed at the lowest altitudes. In a general way the best metallized portions in both basins also occur in those parts of the ore beds which are nearest the sill-like quartz diorite.

H. J. YAGODA: *Localization of chemical constituents by chemical patterns.* A review of printing methods applicable to the study of mineral constituents in polished massive or thin sections. Among the techniques covered are included luminescent phenomena (fluorescence, phosphorescence, and thermoluminescence), autoradiography, electrographic and contact printing.

Material not previously published includes a method for recording an autoluminographic pattern by contacting the phosphorescing specimen against color sensitive film. The use of fine-grained alpha-ray emulsions is described as a means of recording the distribution of uranium and thorium minerals in the polished surface. These emulsions provide a highly selective medium for obtaining a sharply defined autoradiographic pattern, capable of quantitative interpretation and which permits the resolution of fine detail.

A modified contact printing procedure is described which involves the etching of the surface by vapors and the transfer of the corrosion film to a transparent gelatin coating moistened with specific reagents. The characteristic colors serve to localize heavy metals in the polished section.

624TH MEETING

The 624th meeting of the Society was held at the Cosmos Club, December 13, 1944, Vice-president FRANK SHAIRER presiding.

Program.—Presidential address by GEORGE TUNELL: *Some thermodynamic and leptologic threads in the geologic tapestry.*

52D ANNUAL MEETING

The 52d Annual Meeting was held immediately following the 624th regular meeting. The reports of the secretaries, treasurer, and auditing committee were read and approved. Officers for the year 1945 were then elected as follows: *President:* L. W. CURRIER; *Vice-presidents:* A. A. BAKER, W. S. BURBANK; *Secretary:* MARGARET D. FOSTER; *Treasurer:* R. E. STEVENS; *Council:* C. MILTON, W. M. CADY, J. J. GLASS, E. F. OSBORN, HELEN DUNCAN.

The Society nominated GEORGE TUNELL to be a Vice-president of the Washington Academy of Sciences for the year 1945.

Obituaries

GEORGE WHITELEY COGGESHALL, a member of the Washington Academy of Sciences, died on November 19, 1944. He was born at Des Moines, Iowa, on December 21, 1867. He took his B.S. degree at Iowa College in 1890 and a Ph.D. degree in chemical engineering at Leipzig, Germany, in 1895. He attended the Harvard University Graduate School in 1891–92. In 1900 he married Anna Torrey, by whom he had three daughters. From 1895 to 1897 he served as chemistry instructor at Harvard University. In 1898 he organized the Eastern Chemical Co., Boston, and was president of it to 1910, when he moved to Washington, D. C., to become head of the chemical engineering division of the Institute of Industrial Research. In 1924 he accepted a position as head of the research laboratory with the S. D. Warren

Paper Co., Cumberland Mills, Maine, and was associated with that concern until his retirement.

Dr. Coggeshall was an inventor of concentrated fertilizers and several insecticides and fungicides. He developed processes for producing chemical compounds of titanium from rutile, processes for producing potash salts from silicate rocks, and gasoline from heavy petroleum oils. He also did much special work for clients. His publications included a thesis entitled *The constants of calomel electrodes*, and papers on the use of titanium salts in dyeing and mordanting, on the production of potash salts from feldspathic rocks, and on the treatment of the surfaces of concrete vessels. During World War I he was connected with the Section on Concrete Vessel Construction, U. S. Shipping Board. He was a member of the American Chemical Society, Society of Chemical Industry, American Electrochemical Society, Société de Chimie Industrielle, and other scientific organizations. His clubs included the St. Botolph (Boston), Harvard and Chemists' Clubs (New York), and Cosmos and Chevy Chase Clubs (Washington, D. C.).

H. A. GARDNER

LYSTER HOXIE DEWEY, retired botanist of the U. S. Department of Agriculture, died at Kenmore, N. Y., on November 27, 1944, after a long illness.

Mr. Dewey was born at Cambridge, Mich., on March 14, 1865, the son of Francis A. and Harriet (Smith) Dewey. He was educated in the public schools of Michigan, graduating from the high school at Tecumseh in 1885 and from the Michigan Agricultural College (now the Michigan State College) in 1888. He taught botany at the Michigan Agricultural College for two years, and in September 1890 he was appointed an assistant botanist in the U. S. Department of Agriculture. His earlier work in the department was with grasses and weeds, and from 1899 to the time of his retirement in 1935 he was in charge of investigation and research relating to plant fibers other than cotton.

The regions in which Mr. Dewey worked included many different countries. His major investigations in the United States were with flax and hemp, and his selections of these plants resulted in the development of improved strains, eliminating the necessity of importing seed of fiber flax from Europe, and hemp seed from China. In Puerto Rico he conducted experimental work with sisal, henequén, and other tropical fiber plants in cooperation with the Federal Agricultural Experiment Station at Mayagüez. In 1903 and again in 1907 he made field studies of the fiber plants of northern and central Mexico, and in 1911 he represented the U. S. Department of Agriculture at the World Fiber Congress held at Sourabaia, Java. Among the other countries which Mr. Dewey visited and in which he made fiber surveys were Cuba, the Bahama Islands, Algeria, Ceylon, the Federated Malay States, Japan, and the Hawaiian Islands. In all his investigational activities he was devoted to precise thinking and meticulous attention to accuracy. These qualities were evidenced by his long-continued effort to establish a correct and uniform nomenclature for the plant fibers. For many years before his retirement from active service Mr. Dewey was widely recognized both in scientific and industrial circles as the leading American authority on the plant fibers.

He was the author of numerous circulars, bulletins, and articles on grasses, weeds, and plant fibers. After his retirement at the age of 70, in 1935, he prepared the section on fiber plants published in *Standardized Plant Names*, and also a comprehensive series of articles which were published in Spanish by the Pan American Union in a pamphlet entitled *Fibras Vegetales y su Producción en América*, and by the U. S. Department of Agriculture in Miscellaneous Publication No. 518 entitled *Fiber Production in the Western Hemisphere*.

Mr. Dewey held membership in a number of professional organizations, including the Botanical Society of Washington, the Biological Society of Washington, the American Genetic Association, and the Washington Academy of Sciences. For more than 40 years he took an active part in the civic and religious activities of his community, and was a member of the Petworth Citizens Association. He was a member of the Gunton-Temple Memorial Presbyterian Church in Washington, and an elder in that church for 42 years, including 38 years as Clerk of Sessions.

In 1889 Mr. Dewey married Miss Etta Conkling, whom he survived. They had two children, Mary Genevieve, who died at the age of 17, and Grace Marguerite, who is now Mrs. Carl G. Frost, of Kenmore, N. Y.

Mr. Dewey will long be remembered as a man who always rang true. His outstanding qualities were modesty, kindness, devotion to duty, and sterling integrity, and his entire life was characterized by an unselfish desire to be of service and usefulness to others.

HARRY T. EDWARDS.